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SOME NOTES ON THE LIFE HISTORY OF THE MEXICAN GROUND SQUIRREL IN TEXAS

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There is relatively little published on the Mexican ground squirrel *Citellus mexicanus* (Erxleben). Although this study was not completed because the author, on duty with the Army Air Forces, was transferred in the midst of the breeding season, it is desirable to place on record the information on hand. Collections and observations were made at Midland, Midland County, Texas, from August 15 to September 24, 1944, and continued at San Angelo, Tom Green County, Texas, from September 25, 1944, to May 10, 1945.

I wish to express my gratitude to the following persons for their kind and helpful assistance: Dr. Charles E. Foster, Department of Biology, Colgate University, for identification of the fleas; Dr. Oran B. Stanley, Colgate University, for photographing the squirrels; Jesse T. Couch, San Angelo, Texas, for permission to study burrows on his property; and Dr. Henry Dietrich, Department of Entomology, Cornell University, for confirmation of the identification of the pinacate bettle and for information about the genus. Especially I want to thank Dr. John Eric Hill of the American Museum of Natural History, New York City, for critical reading of the manuscript. My wife aided in collecting specimens and in making observations.

Habitat.—The Mexican ground squirrel at both Midland and San Angelo showed a preference for sandy and gravelly soils. Many squirrels were observed amidst a prairie dog colony near Midland on a clay soil, but close observation revealed that most of the squirrels wandered about the town, using old *Cynomys* burrows for refuge, if necessary, and maintained their permanent homes in the gravelly loams surrounding the area. This was doubtless due in part to the fact that squirrel burrows are susceptible to flooding in slower draining clay and silt loam soils.

It was evident that the more succulent growth had tempted some squirrels to the river bottoms, but these were periodically eradicated by the flash floods that occur in this region. The animals have readily adapted themselves to civilization, especially in such places as cemeteries, parade grounds, and other areas where grass is encouraged and not too closely or too often cut. Even so, I observed some squirrels on lawns between barracks on the San Angelo Army Air

Field. They managed to maintain their main burrows on the lawns and used drainage pipes in lieu of refuge burrows. They also took shelter under the buildings.

The predominant forms of vegetation in the territory were scrubby mesquites (*Prosopis*), prickly pear (*Opuntia*) and grasses. The various grasses (*Sorghum halepense, Stipa, Bouteloua, Hordeum*) were scattered to abundant, depending on soil and exposure. Some members of the Asteraceae, especially firewheels (*Gaillardia pulchella*) and Engelmann's daisy (*Engelmannia pinnatifida*) were widespread and gave color to these relatively barren areas. Pin clover (*Erodium*), buffalo bur (*Solanum*), croton (*Croton*), Indian mallow (*Abutilon*), wild verbena (*Verbena*), false leek (*Nothoscordum*), horehound (*Marrubium*), ground cherry (*Physalis*), and moss rose (*Portulaca*) were widely, although sporadically, distributed.

Other small mammals I found in the region were two species of pocket mice, *Perognathus merriami gilvus* and *P. hispidus hispidus*. Cottontails, *Sylvilagus floridanus* (*chapmani?*), and jackrabbits, *Lepus californicus*, were abundant. The ground squirrels were by far the most numerous mammal. One Norway rat, apparently just wandering, was caught near a burrow that was too small for it to enter.

Burrows.—To determine their characteristic construction, approximately 50 burrows were excavated. These were not always easily found except when a young squirrel was digging its home, or a female was excavating her brood chamber because there is little or no dirt pile at the entrances. Refuge burrows, which greatly outnumbered main burrows, led to much fruitless digging on our part. Occasional burrows were found at the bases of mesquite bushes or prickly pear; however, many more were found in the middle of grassy plots (Plate 2, nos. 3 and 4). Another favorite burrowing place, observed both at Midland and at San Angelo, was in the middle of the smaller dirt roads. Wherever possible, the squirrels had dug their burrows down through, and then along under, the hardened six-inch layer of caliche that was so common 2 to 3 feet below the surface. In digging them out the use of a pick was necessary. The holes were completely excavated and then drawn freehand using a yardstick and a tape measure to get their dimensions wherever desired; angles of descent were determined by plotting and then measuring, or by trigonometry.

Burrows varied greatly in angle of entrance—from a mild slope to an absolute drop. The depth of the hole did not appear to influence this angle. A burrow with an entrance that dropped vertically for 17 inches leveled off at this point and did not go any deeper. Another, entering at approximately 30°, descended to a depth of 50 inches before it began to level off. The majority descended at an angle between 30° and 50°. In cross section the burrows were approximately round, or oval with the long axis vertical. They varied from $2\frac{1}{2}$ inches to $3\frac{1}{4}$ inches in diameter. The holes of adult squirrels ranged from 12 inches to more than 50 inches in depth, averaging 20 inches.

The brood chamber was almost always constructed in the deepest part of the

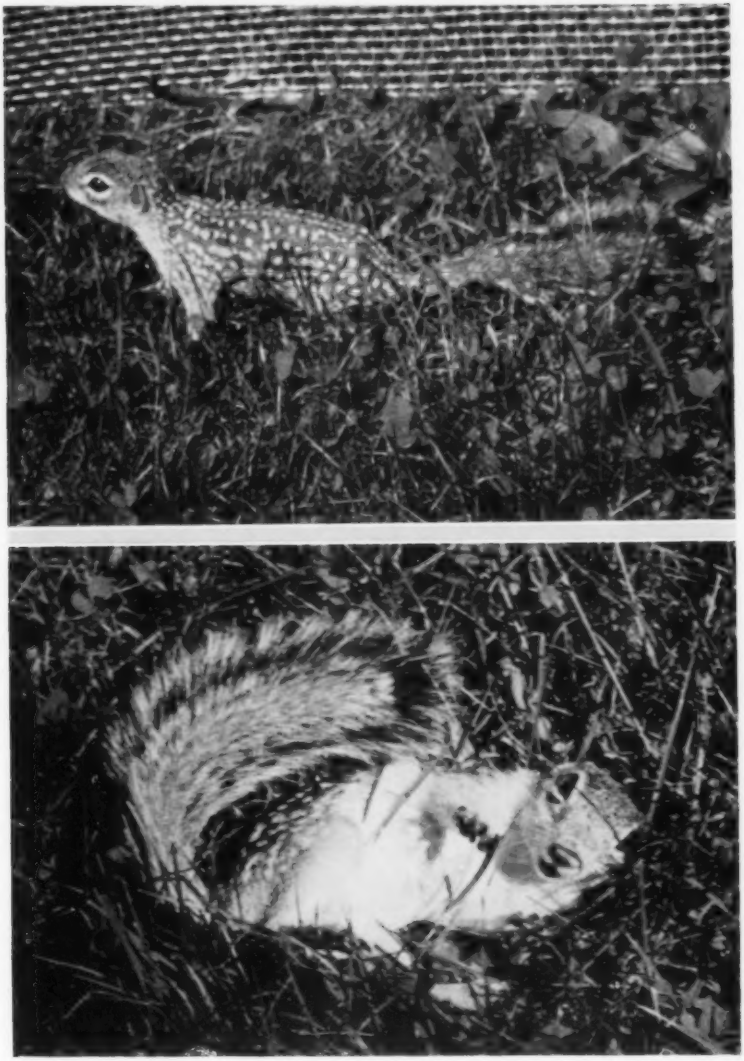


PLATE I

UPPER: Female *Citellus mexicanus parvidens* (Mearns) in a semi-alert pose. The tail is "bottled-brushed" more than normally because the squirrel is excited.

LOWER: Ground squirrel in defensive position. Lying on their backs in this fashion they are better able to defend themselves when cornered. When so pressed, they hiss and grind their teeth. Photographs by Dr. Oran B. Stanley.

burrow. This was not the case, however, with the nest rooms of male squirrels and immatures. The brood chamber usually terminated an off-shoot tunnel. It never ended the burrow. Spheriod in shape, it measured 7-to 8 inches in dia-

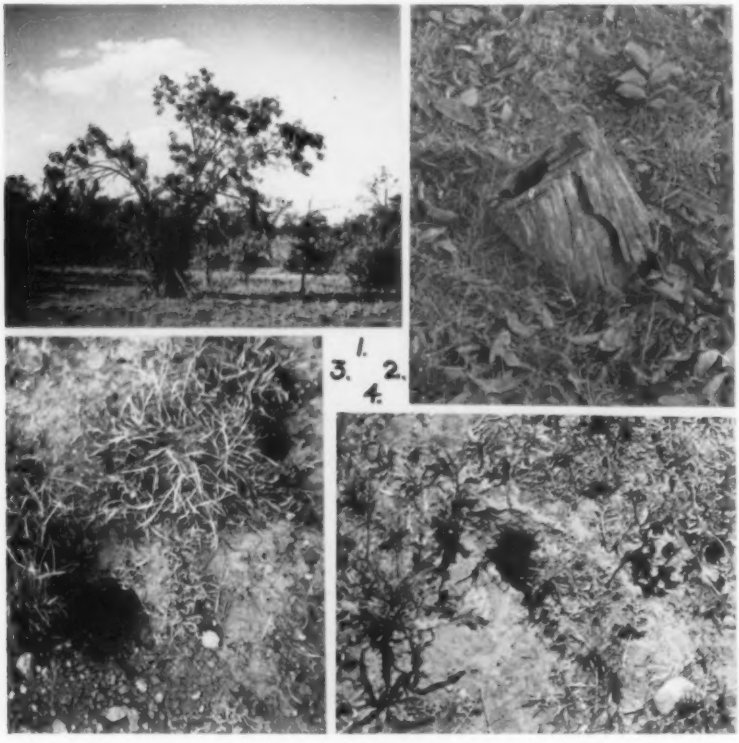


PLATE 2

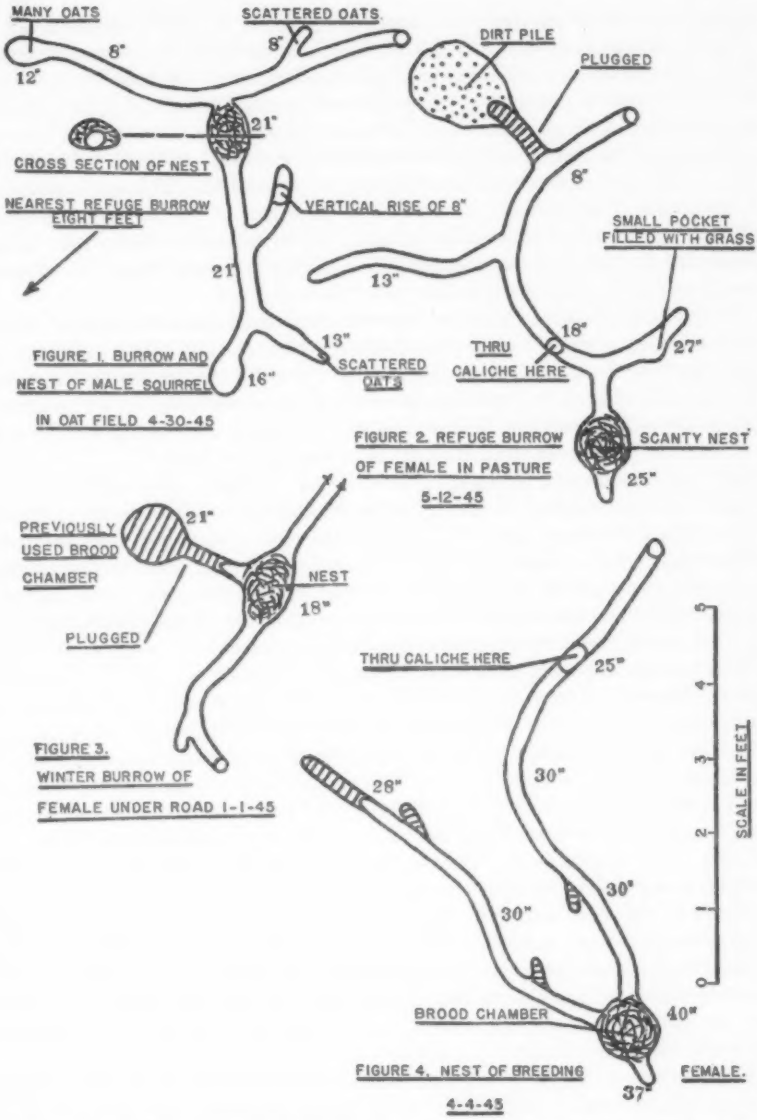
(1) A view of the mesquite brushland near San Angelo, Texas. Squirrels were numerous in this type of habitat but not as dense or as localized as they tended to be where there was less cover.

(2) An enterprising squirrel had hollowed out the soft center of the stump to a depth of four feet for use as a refuge hole.

(3) A photograph of the two entrances diagrammed in fig. 2. This picture was taken while the squirrel was still excavating. The large whitish chunks in the dirt pile are bits of the hardened layer of caliche, through which the squirrel burrowed.

(4) The entrance to the home burrow of an adult male squirrel. Notice the lack of a dirt pile, typical of the majority of dens of adult squirrels in this region. The nearest cover higher than that shown in the picture is 15 feet away.

meter. Sometimes these rooms had small concealed blind pockets. A majority of the burrows in which broods were raised had a basic V-shaped plan (fig. 4). One branch of the V in this burrow developed when the nest chamber was con-



FIGS. 1-4. Semi-diagrammatic drawings of burrows of *Citellus mexicanus parvidens* (Means) excavated on the property of Mr. Jesse T. Couch, San Angelo, Texas. Figures denote depth of burrow in inches.

structed, all dirt from the excavations being carried through it (Plate 2, no. 3). After the family had scattered, the nest material was in all cases observed to have been removed and disposed of or used in a sleeping nest. The brood chamber was then filled with dirt from new construction and ceased to exist (fig. 3). No burrow examined had been used twice for rearing families.

Male squirrels, and females after the breeding season, enlarged a deeper portion of the burrow for nests in which to sleep and rest. This occurred in the main tunnel or occasionally in an off-shoot passage. When the nest was placed in the main tunnel, a short escape tunnel usually branched out at right angles, concealed by the nesting material. The squirrels passed their short winter period of inactivity in these nests.

Bailey (1931) reports that these squirrels apparently have the habit of closing their burrows. None that we had under surveillance closed their entrances for any length of time. However, during April when the females were constructing the brood chambers, the entrances were often closed, but only, as we had many opportunities of observing, because the squirrel was in the process of excavation and had not yet cleared the dirt from the entrance. On April 26, a male squirrel that had his burrow plugged with dirt by a heavy rain had both entrances blocked off and on all day while he cleared out the tunnels. During January and February, rain often plugged the winter burrow of a female under observation. After clearing the entrance several times, which indicated that the squirrels do not like to have their burrows closed, she gave up the hole and and moved to another nearby. Two burrows that were plugged at one entrance and left closed several weeks were excavated by us and found empty. One old closed burrow was trapped and a specimen of *Perognathus hispidus* was caught there. However, during the winter, many burrows were excavated and not one yielded a squirrel (other than those in which we knew squirrels were living). This may be explained in part by the high proportion of refuge burrows, approximately five to one, which cannot be distinguished from the home burrow externally. Also, badgers visited many burrows and, although they did not always get their prey, messed up the entrances so much it was impossible to finish our digging. Perhaps some of the burrows in which there were squirrels were plugged and missed by us for that reason.

Many of the older burrows, judged by their length and the presence of old nests, were found to have one or more entrances abandoned and filled with dirt as were the brood chambers when no longer needed. During April and May, four squirrels under observation changed the position of at least one entrance, clearing and excavating the burrow through the old passage and then filling it completely with more dirt.

Refuge burrows were generally old burrows that had been partly filled, due to rain usually, or burrows dug for that specific purpose. They averaged about two feet in length. These burrows all had a large insect population on which the squirrels undoubtedly feasted periodically. In them many large spiders had built smaller off-shoot tunnels. Beetle larvae were commonly found in the earth surrounding the tunnel. Multitudes of camel crickets (*Ceuthophilus*) and pinacate beetles (*Eleodes*) were found in infrequently used burrows.

The pinacate beetle or stink bug (*Eleodes*) and the Mexican ground squirrel had a relationship that was almost commensal. It would have been so had not the squirrels eaten so many of them. Adults, larvae (in the nest), and pupae were all found in the burrow or the earth immediately surrounding the burrow. As most of the larvae, which are commonly called false wireworms, found in the nest were large, 20 to 30 mm, it is likely that they go down into the holes preparatory to pupating. Most pupae were found in the earth adjacent to nests, 3 or 4 inches in from the burrow wall.

The squirrels dug with their fore feet and pushed the dirt out with kicks of the hind feet. They did not seem to be very rapid excavators. One squirrel dug a burrow 4 feet long, averaging 12 inches deep, in soft stoneless soil in four days.

Dung was seldom found in any of the nests or passages of the burrows. There was no provision in the form of an offshoot tunnel for defecation and urination. The squirrels did, however, have a defecation area outside the burrow in many instances. The scats were never piled, but rather broadcast over a space about a foot and a half square. Captive squirrels occasionally used corners of the cage as a repository.

Nests.—The brood nests were constructed of the various grasses found in the vicinity of the burrow. They also contained leaves and small twigs of mesquite. Some had portions of the coarser flowering plants found locally. The nest completely filled the chamber, which averaged 7 inches in diameter. The material in a typical nest weighed 70 grams. There was no obvious entrance, the squirrel apparently pushing through the loose material. The nests we found were not differentiated, having no special clinging or outside protection. Nests of males and wintering nests of females were similar in construction. Females appeared to make better nests than males and used less trash. The nest of one male was made up almost entirely of feathers and chewed up bits of paper. Another was almost entirely of redtop (*Sorghum vulgare* var. *saccharatum*) leaves. It weighed 45 grams. One female had made her winter nest of grasses and mesquite leaves; it weighed 56 grams. We observed that the squirrels sleep under rather than within the nest material. The nests of the squirrels were almost without exception occupied by *Eleodes* larvae.

Caged squirrels showed the same difference in ability to make nests. The females were never satisfied and were constantly adding to their nests anything they could find, including materials not ordinarily used in the wild, such as wool and feathers. They pulled and pushed it into an igloo-shaped blanket. Males pile the trash in one corner, if they do anything, and dive under it when frightened.

Reproduction and young.—Squirrels were observed playing in pairs for the first time on April 1. They chased each other much as red squirrels do. First one then the other would pursue. After several of these rushes, which never went very far, they rested side by side. The squirrels were noticeably cautious, ceasing all play and standing "picket pin" at any slight disturbance. They occasionally sniffed at each other in a bored fashion, and then were off again, their tails fluffed out like bottle brushes. Once after a male had rushed a female several times, at each of which she whirled to face his attack, they were observed

to behave as if mating. I cannot be sure of this because the light was poor. During this interval of about 15 seconds, one of the squirrels emitted a constant undulating chitter. After this they separated and each went to its burrow. Squirrels were seen in such pairs for a week, after which they separated. The composition of the pairs appeared to be constant.

A female squirrel collected on April 4, (RLE no. 813) had ten 4 mm embryos (crown-rump length), eight in the right horn and two in the left. This was the only female sacrificed. All others were saved for the young. Male squirrels collected in March and April had descended testes. By May 6, however, they were beginning to ascend. Wade (1927) records a similar short period of sexual activity in *Citellus tridecemlineatus*.

A female squirrel that had been caged with a male from April 1 to May 5 gave birth to one offspring on May 10. No remains of any others could be found in the cage. She paid no attention to it. It lost one gram in two days, and was dead on the third. On May 14 she gave birth to another. Upon examination, it was found that she was far from through. She gave birth to two more on May 15, and on May 16 still another. Of these she ate two, so I preserved one to insure having a specimen.

The new born squirrels were pink all over and almost naked, with only short (1 mm) scattered fuzz. The vibrissae were 2 mm in length. The eyes and ears were closed. When disturbed, the babies emitted sharp, complaining squeaks. Their forearms were well developed and they inched along rapidly, although they had difficulty in staying upright and constantly rolled over as they progressed. They were extremely active at all times and reacted quickly to stimuli. Weighed within 12 hours after birth, four babies averaged 4.31 grams (3.85–5.05). They measured: total length, 66.5 mm (63–69); tail, 13.9 mm (13.5–14); hind foot, 8.6 mm (8.0–9.0).

The average measurements of nine immature squirrels, seven females and two males, collected in August were (in millimeters): total length, 275.9 (254–295); tail, 117.4 (110–122); hind foot 41.5 (40–43); ear 10.1 (10–11).

Seven females and two males collected in September averaged: total length 280 (250–295); tail, 122.6 (109–130); hind foot, 40.8 (39–42); ear 10.1 (10–11).

Inasmuch as the adults collected seem to be considerably larger than those listed by Howell (1938), their dimensions are detailed below. Nine females averaged as follows: total length, 313.8 (285–332); tail, 120.9 (104–134); hind foot, 40.4 (36–44); ear, 10.2 (8–12); weight, 174.6 (137.4–198 grams). Eight adult males averaged: total length, 320 (299–352); tail, 125.5 (108–134); hind foot, 42.75 (39–46); ear, 10.9 (8–12); weight, 254.4 (227.6–330.8) grams.

Observation of immature squirrels in August and September showed that they were capable of individual existence within at most three months of birth. They occupied old burrows, and some of the mothers' refuge burrows, digging some of them a little, usually enlarging a room at the end for their nest. Their nests were a heterogeneous collection of paper, string, grass, leaves, and pieces of cloth.

Unfortunately, before other young were born the author was transferred from

Texas and the study had to be terminated. Two pregnant squirrels were brought East but they ate their young, which were born in transit.

Food.—Many times the squirrels were observed chasing flies and other insects. Bailey reports that in June about half of their food consists of insects. Old unused burrows have a large insect fauna that ones in use do not have. It seems likely that the squirrels eat all insects encountered in their burrows. A cursory examination of several stomachs from the San Angelo region indicated that vegetation forms the bulk of their diet, at least in the spring. They ate mesquite leaves and beans in quantity. One squirrel was observed chewing on new leaves of agarita (*Berberis trifoliolata*). The berries also were eaten. They fed on most of the herbaceous plants found around their burrows. A favorite was the Shasta daisy (*Aphanostephus skirrobasis*). Johnson grass (*Sorghum halepense*) and pin clover (*Erodium*) were eaten in quantity. They raided oat fields occasionally. The only burrow excavated that contained stored food had about one hundred grains of oats in various parts of the burrow (fig. 1). The only other food I found in their dens consisted of the gourds and seeds of the calibacilla (*Curcurbita foetidissima*).

Caged squirrels exhibited cannibalistic tendencies. Whenever one squirrel killed another, it generally ate part of its victim, usually the viscera and the head. Young English sparrows placed in the cage were eaten with relish, showing a distinct taste for young birds which in the wild may easily have been satisfied by young lark sparrows, as the nests of these birds were abundant and usually placed on the ground. Skinned carcasses of mice were readily consumed. Lettuce, cabbage, apples and all kinds of dried fruit and nuts were eaten. Those squirrels handy to the oat field ate many of the plants and later the grains. Their depredations were not as noticeable, however, as were those of *Perognatus hispidus*, which consumed and stored vast quantities.

Behavior.—The Mexican ground squirrel is colonial but not sociable except during the breeding season. On the other hand, it is not aggressive. The squirrels under observation all had a fairly definite territory and a series of refuge holes, but they tolerated other squirrels in that territory if they did not get too close. They did not tolerate another squirrel entering their home burrows, nor any others that they might be occupying at the time. Close company, even under duress, was a fighting matter. The range roamed by one squirrel seldom exceeded 100 yards in diameter, usually no more than half this. They tolerated considerable overlapping so squirrel populations tended to be spotty. The young sometimes did not go farther than 50 feet from the brood den. One area of about 50 acres near San Angelo, all of it acceptable to squirrels, had a population estimated at 20 squirrels, of which 18 lived within an area 100 yards in diameter. This localized type of distribution over a small area was evident wherever squirrels were found.

Intolerance of close company was evident in caged animals. One pair of squirrels, captured in the midst of the mating period, were caged together and the male killed the female before morning. Many experiments were made caging these animals together, and the only successful one was with two young females,

captured at the same burrow and assumed to be nest mates. They lived together from September to February without fighting. They are very difficult to tame.

The squirrels observed had decidedly different personalities. One at Midland, Texas, allowed people to walk within 4 or 5 feet of it while it ate. Others would trill and run for their dens, tails bottle-brushed and held rigidly vertical, if anyone approached within 150 feet of them. Some squirrels sat in the entrances of their burrows and trilled, occasionally giving a jerk with their tails, until approached within 2 or 3 yards. They disappeared then, trilling once or twice from down under, only to reappear shortly if one were quiet. Others quietly descended at the slightest disturbance, to remain 20 or 30 minutes. For the most part, however, they were highly inquisitive. I used a car for most of the observations. It was possible to get within 10 or 15 feet of the squirrels in this manner. When first approached they usually stood up "picket pin" fashion for several minutes, surveying the car. After this they paid it no attention whatever.

When standing "picket pin", they stood on their hind feet, occasionally on their toes, using their tails for balance. The tail tended to be parallel with the ground but did not always touch it. They rose in stages, robotlike, arms dangling in front. This jerkiness of movement was pronounced. When foraging, their motions were spasmodic. They hugged the earth like snakes. When eating, they stood up or sat in a crouched position. Small plants were cut at the base, at which point they started eating and continued up, eating stems, leaves and flowers. They stood up and picked tender leaves off the taller plants with one paw, balancing with the other. They often used their paws individually in eating. The squirrels we observed slept in the conventional squirrel position, curled up with the head tucked under the abdomen between the hind feet, and the tail curved up over the back.

They cleaned themselves much as does any other animal, although perhaps not so often. To clean their hind feet, they lay on their sides and pulled them forward with the fore arm on the same side. The tail was held in both hands when cleaned. When teased, the squirrels lay on their backs, feet in the air, slightly curled up.

The last squirrel observed in the fall was seen November 20 feeding on mesquite leaves and Johnson grass. It was very active. When captured and placed in a cage with two other squirrels, it was promptly killed by the others. It had no obvious adipose tissue. An adult female (no. RLE 775) collected on September 3 was well prepared for the winter with a heavy layer of fat. Squirrel activity was evident throughout the winter; however, none was actually observed until February 25, when squirrels were busily occupied in cleaning out burrows.

Caged animals did not hibernate during cold weather, although more exposed to the elements than squirrels in burrows. For one short period of three days, not during one of the colder spells, the two caged squirrels approached hibernation. Their body temperature fell to approximately 50° F. and they responded weakly and slowly to stimulus. After that there was no repetition of the condition. Although the weather continued as cold or colder, the squirrels were as

active as ever. A similar torpid condition resulted when the squirrels got wet. They appeared dead after being exposed to rain for several hours, but when warmed and dried they quickly regained their former friskiness.

They defecate in quantity when excited. Fresh scats are ovoid in shape, olive brown to black in color, and average 12 by 4 mm.

Voice.—The squirrel has a decidedly birdlike trill. It is clear, penetrating and ventriloquistic. Lasting one to three seconds, it trails off at the end. It is easily mistaken for the song of the lark sparrow, which is not quite as regular in pitch. The squirrel trills when alarmed. The mouth is opened, the tongue depressed, and the whole body vibrated as the trill is given. A low throaty version of the trill, on the order of a growl, is indicative of aggravation. The teeth are clicked, and the animals hiss and chatter when fighting.

Predation.—Only one case of predation was actually observed. In May, a Swainson hawk (*Buteo swainsoni*) was seen carrying off a large squirrel. Mrs. Bailey (1928) lists many predators of *Citellus*. Of those, the red-tailed hawk (*Buteo borealis calurus*) and the pallid horned owl (*Bubo virginianus pallescens*) were observed in numbers during the study. The owl was seen just after sundown, so it doubtless caught many squirrels as they sometimes wandered around until it was almost dark. Many times Cooper's hawks (*Accipter cooperi*) were seen gliding among the mesquites in squirrel territories, and they may well have caught a few squirrels in addition to the small birds they prefer. Many pellets of burrowing owls (*Speotyto cunicularia*) were examined for ground squirrel remains, but none was found. Snakes were almost non-existant in the regions studied.

In the winter, the badger (*Taxidea taxus berlandieri*) dug up almost every squirrel burrow in one area of nearly 100 acres. That badgers were not entirely successful was evident when the squirrels became active in March. Many had to use the burrows the badgers messed up until they could dig or look up new ones. The badgers did little digging for squirrels in the spring and summer.

Parasites.—With the exception of Siphonaptera, the ground squirrels studied were remarkably free from external parasites. No ticks or cuterebrid larvae were found. The fleas were identified as *Opisocrostis bruneri* Baker.

LITERATURE CITED

BAILEY, FLORENCE MERRIAM. 1928. Birds of New Mexico. New Mexico Dept. Fish and Game, pp. 1–807, 79 pls., 136 figs., 60 maps.

BAILEY, VERNON. 1931. Mammals of New Mexico. U. S. Dept. Agric., Bur. Biol. Surv., N. A. Fauna, no. 53, pp. 1–412, 22 pls., 58 figs. (maps).

HOWELL, ARTHUR H. 1938. Revision of the North American ground squirrels, with a classification of the North American Sciuridae. U. S. Dept. Agric., N. A. Fauna, no. 56, pp. 1–256, 32 pls., 20 figs.

WADE, OTIS. 1927. Breeding habits and early life of the thirteen-striped ground squirrel, *Citellus tridecemlineatus* (Mitchill). Jour. Mamm., vol. 8, no. 4, pp. 269–275, 1 pl., 2 figs.

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THE SEX REACTIONS OF PORCUPINES (ERETHIZON D. DORSATUM) BEFORE AND AFTER COPULATION

By Albert R. Shadle, Marilyn Smelzer, and Margery Metz

Since the white man first colonized America, he has known the Canadian porcupine. Although it is still common in many of our heavily wooded areas, it is not well understood and many facts about these interesting animals await discovery. Because the porcupine is largely nocturnal in its habits, little or nothing has been known about its courting and mating reactions.

For several years we have kept a colony of 8 to 12 porcupines at the Biology Department of the University of Buffalo, and the activities of these captive animals have been the source of the observations here recorded.

ACKNOWLEDGMENTS

We are greatly indebted to the Allegany State Park Commission and to Mrs. and Mr. Donald Spencer of the United States Fish and Wildlife Service for their cooperation in obtaining the animals, and for their many kindnesses and generous aid.

MATERIAL

The main animals involved in these observations are three females, (Maudie, Nightie, and Prickles) 8.5, 2.5, and 1.5 years old respectively, and three males, (Old Dad, Johnnie, and an albino, Pinkie) 9.5, 3.5, and 3.5 years of age respectively. Many observations were made on other individuals including two mature, female, yellow-haired porcupines, *Erethizon d. epixanthum* (Anderson and Rand 1943).

TACTILE REACTIONS

Under ordinary conditions, porcupines have a very keen tactile sense, for the long stiff hairs of the dorsal and lateral parts of the whole body and head are associated with very sensitive skin structures, and the average animal usually reacts quickly and sharply to their stimulation. Most of the animals, particularly mature ones, usually object to being stroked or petted, unless they have been used to it since they were young. They object particularly to having their feet or the long hairs about the base of the tail and the genital organs touched. The females are usually just as sensitive as the males, and except during the late summer and the fall, the females may seem even more sensitive than males to tactile stimuli in the genital region.

PRE-COPULATORY REACTIONS OF FEMALE

The mating reactions of the female may be divided into three periods, precopulation, copulation, and post-copulation. Only the first and last periods will be described here for the copulatory period has already been described by Shadle (1946).

In the female, one of the first suggestions of the approach of the mating season

is a reduction in negative reaction to tactile stimulation of the hairs about the genital region. Later the female occasionally stimulates her genitals by rubbing them on some protuding structure, such as a stick, a food or water crock, or the frame or wire of the cage. These activities of the female may begin as early as late July or early August. The genitals at this time are likely to be somewhat enlarged and are more or less charged with blood.

As the autumn season progresses, the sensitivity about the genital region becomes progressively less marked and eventually the female accepts, and may seek more frequently, the tactile stimulation of the genitalia. Some younger females may exhibit a tendency to greater activity, but the older females seldom do. Greater nervousness and excitement on the part of the younger females are evidenced by an inclination to run, play, climb rapidly, gnaw in a quick, nervous manner, and they may also put more vim, vigor, and action into their exercise, as previously described by Shadle (1944). Yawning, chattering the teeth, rubbing noses with another porcupine, or rubbing the side of the nose against other objects, may be common activities at this time. The females may even seize, straddle, and ride sticks about the cage. Holding the long stick with the forepaws, the animal stands erect as it walks about astride the stick, thus stimulating the genitalia by contact with the stick.

As the rutting season reaches the peak, the female may appear to mope for several days. She is more or less inactive, sits near the male, may eat little or nothing, but when the genitals are mildly stimulated by a tactile or an olfactory test of the male, she may make no objection, and may even attempt to rub her genitals against the stimulating object.

At the culmination of the heat period, when the female is ready to mate, any stimulation of the hairs at the base of the tail and genital area results in (1) the raising of the tail, (2) baring of genitals, and (3) actively seeking greater contact with any object which touches the labia or enters the vagina. At this time, the entrance of a thermometer into the vagina is as readiy accepted as a copulatory organ, while at other times, in taking a vaginal temperature, the female objects strenuously to the insertion of the thermometer.

These pre-copulatory developments in the female may extend over a period of three months or more and usually reach their maximum during November or early December.

The records of porcupines born in July (Snooks—July 22, 1941) (Skeezix—July 7, 1944) suggest that there may be a period of heat in January if the animal has not previously been impregnated. Additional information is needed on the length of the gestation period. The evidence on hand, suggests that the gestation period may be nearer seven months than four months, and this agrees with Taylor's (1935) estimate.

The reaction of the female during copulation, as described by Shadle, (op. cit.) occupies only a few hours and is a short, very active period during rut which usually occurs in November or December, but may occur in January. This act is followed within three to five hours by the onset of the post-copulatory reactions.

POST COPULATORY REACTIONS OF FEMALE

The post-copulatory reactions may extend from several weeks, to as many as four months. As one might describe the pre-copulatory period as a "warming-up period", so the post-copulatory period might be described as a "cooling-off period". The same general reactions of the female are evident in both periods but in the post-copulatory period they occur in the reverse order to those of the pre-copulatory period. While the reactions of seeking stimulation of the genitals are likely to increase in intensity during pre-copulation, in the post-copulatory period these reactions tend to decrease in intensity, or fade out. This finally results in the female again becoming extremely sensitive about the genital region.

At no time have the females exhibited among themselves the pugnacity so common in males, and they are usually more docile than the males.

MALE COURTING REACTIONS

While the females show interest in the male over several months, the male shows sexual urge of somewhat variable intensity throughout the year. With a well-grown, sexually mature male in the laboratory, sexual activity is likely to be demonstrated at any time, particularly when he hears the call of another porcupine, smells materials which have been in contact with another porcupine, especially a female, or when he is put into the same cage with a female.

When the male is introduced into the female's cage, he first goes on a tour of the cage, and everything in it—the walls, the floor, feed and water containers, etc., are given a thorough olfactory examination. Places where the female has urinated, especially if they are still wet, are given especial attention and the male will often sit for several minutes picking up, one after the other, pawfuls of the urine-soaked shavings or straw from the floor, to sniff them thoroughly. Erect on his hind legs, he may also walk about the cage while sniffing a pawful of shavings or other materials from the floor. This may be repeated many times as each pawful of material is examined. From the cage floor, sticks which have come in contact with the female's genitals, urine, etc. will also receive attention. If the stick is a foot or two long, the male will often grasp it in his paws, straddle it and go about the cage riding it as the female did. The male may often walk about the cage on one front leg and the hind legs, while he holds the other front paw on his genitals. In the males observed, usually the left paw was held on the genitals, and after the male urinated on that paw, he often gave it an olfactory test during, or after this "three-legged walk". In caged animals, the accumulation of urine, other secretions, and dirt may cover the paw so used with a crust of filth, but this material probably would be washed off by dew and rain in the wild state.

Like the females, but to a much greater extent, the males go about the cage rubbing their genitals more or less vigorously over all sorts of structures in the cage. This activity occurs throughout the year but is most evident during the mating season, November and December. The greater the projection used, the more satisfaction seems to be derived from it, and one male used a heavy spike which projected about an inch and a half from the timber of the cage. The

genitals were rubbed so vigorously on the spike that it was removed to keep the animal from injuring himself upon it.

When the males are sexually excited, they are likely to vocalize more or less. The "singing" as we call it, may vary from an almost inaudible low whine in slight excitement, to a high-pitched, piercing whine in an animal which is greatly excited. There is also some individual variation in the vocalization. Some males usually "sing" in a low tone, some have a moderate whine, while others are so loud as to be almost disagreeable. Males are likely to be pugnacious and readily fight with other males encountered, especially during the autumn and early winter.

Another common action of the male is to rub the side of his nose against objects in the cage, very much as a rabbit goes about a strange hutch rubbing his chin gland on the parts of the hutch.

One of the most unusual parts of the porcupine courting reactions occurs when the male approaches the female and has olfactorily tested her body and especially her genitals. If he is sufficiently stimulated sexually, he sniffs at her, rubs noses with her, then rears upon his hind legs and tail and walks erect towards the female, usually with his penis fully erected. If she is not in advanced stages of heat, she will probably run away. On the other hand, if she is in advanced stages of heat, she too, will rear on her hind legs and tail and turn to face the male after which they may rub noses. As they stand facing each other, a few inches apart, the erected penis of the male begins to discharge urine in frequent, short spurts which in less than a minute may thoroughly wet the female from nose to tail, especially her ventral and lateral areas. During the process, the female may (1) object vocally in short, sharp grunts, or cries, (2) reach and strike with her arms in a sort of sparring manner, (3) threaten or try to bite or, (4) at the first opportunity vigorously shake off the urine and run or walk away. If near the point of mating, she may offer only perfunctory objections to the urinary shower. The quantity of the urine used and the force with which it is discharged are surprising. The discharge of the urine breaks it up into a shower of drops, and it was often possible to measure on the concrete floor outside the cage, the distance to which the drops were thrown. The greatest distance measured to which the drops were discharged was six feet and seven inches from the point where the animal stood to the point at which the drop first touched the floor, then broke up and scattered. No definite function has as yet been discovered for this unusual urinary shower to which the female is subjected.

One male, Johnnie, showed a slight variation of this part of the courting. As the two animals were reared on their hind legs, Johnnie would often attempt to rush the female and a momentary wrestle would ensue. It appeared to be an effort on the part of the male to over-balance the female so that she would fall on her back and thus enable the male to make a ventral sexual contact, as she was lying prone. Taylor (1935) cites such a case reported by M. E. Musgrave; "The female lies on her back, the male above her, belly to belly." In no case which we observed was the process successful, and after witnessing two cases of copulation (Shadle *op. cit.*) one is inclined to question the reason for Johnnie's wrestling activity.

DISCUSSION

Struthers (1938) observed that even when he kept porcupines in groups, the males and the females paired off and each male became very attentive to one female, and the pair was often seen rubbing noses.

Although our animals had no opportunity to pair off (because they were kept in separate cages), it seems evident from their reactions before and during copulation (Shadle *op. cit.*) that a preliminary acquaintance is advisable and possibly necessary to bring about the copulatory act of porcupines. Both "Pinkie" and "Johnnie" refused to cover either of the rutting females, although both males were in cages next to, or quite near the two females.

Our males were more likely to follow the females than vice versa, as Struthers found with his porcupines.

Taylor (*op. cit.*) says, "A trapper (Michigan 1910) told Birdseye he once saw a pair of porcupines copulate, standing up belly to belly". From the previous description of the courting reactions of the porcupines, it is evident that the trapper misinterpreted what he saw. Instead of seeing the copulation he saw the part of the courting which usually results in the male showering the female with urine. This may preceed copulation by several days to some weeks and may occur many times. Due to the position of the genitals of the two sexes, two porcupines standing on the hind legs, belly to belly, would not be able to make sexual contact.

Taylor (*op. cit.*) reports, "The earliest physical signs of sexual activity were observed (in Arizona) in a female taken August 24, 1925". Our females began to show signs of sexual activity in late July and the early part of August, and continued through the fall and winter until March.

SUMMARY

Among the foregoing observations on porcupines (*Erethizon d. dorsatum*) in the laboratory, the following points were evident:

A. Male procupines exhibit more or less sexual urge throughout the year.

B. Evidences of sexual urge in males were:
   1. Olfactory examination of nearly everything encountered, including other porcupines, materials, objects, etc. with which they came in contact.
   2. Especial olfactory tests are given to the female, her cage, her urine, her genitals.
   3. Vocalizing; rubbing of noses.
   4. Showering female with urine; three-legged walk; rubbing of genitals on protuding objects; straddling sticks; pugnacity and willingness to fight other males.

C. Female porcupines show a shorter period of sexual urge, divisible into three periods of sexual activity.
   1. Pre-copulation period: three or four months of gradual development of heat or rut: the "warming-up" period may begin in late July or early August.

2. Copulation period: a short, very active peak of heat of a few hours duration which usually occurs in November or December, but may occur in January.
3. Post-copulatory period: apparently a gradual "cooling-off" process, lasting several weeks to four months, a reversal of activities of the pre-copulation period.
4. Evidences of the sexual urge in female: gradual variation in tactile sensitivity about the genital organs. Rubbing genitals on protuding objects; straddling sticks, etc.; enlargement and turgid condition of the genitalia; active, playful, nervous reactions; sparring during urinary shower; moping habit and lack of appetite near onset of copulation period; remains close to male.
5. Female shows extreme sexual urge during period of copulation; for a few hours very receptive to male's attentions; sexual receptivity is lost within three to five hours following copulation, then repels male.

LITERATURE CITED

ANDERSON, R. M. AND A. L. RAND. 1943. Variation in the porcupine (Genus *Erethizon*) in Canada. Can. Jour. Res., vol. 21, pp. 292–309.

SHADLE, A. R. AND WM. R. PLOSS. 1943. An unusual porcupine parturition and development of the young. Jour. Mamm., vol. 24, no. 4, pp. 492–496.

SHADLE, A. R. 1944. The play of American porcupines (*Erethizon d. dorsatum* and *E. d. expizanthum*). Jour. Comp. Psy., vol. 37, no. 3, pp. 145–150.

SHADLE, A. R. 1946. Copulation in the porcupine. Jour. Wildlife Mgt., vol. 10, no. 2, pp. 159–162.

STRUTHERS, P. H. 1928. Breeding habits of the Canadian porcupine (*Erethizon dorsatum*). Jour. Mamm., vol. 9, no. 4, pp. 300–308.

TAYLOR, W. P. 1935. Ecology and life history of the porcupine (*Erethizon epixanthum*) as related to the forests of Arizona and the southwestern United States. Univ. of Arizona and the southwestern United States. Univ. of Arizona Bull., vol. 6, no. 5, Tuscon, Arizona.

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ON THE DECOYING OF COYOTES

By J. R. Alcorn

That coyotes can be called up to within a few yards of a concealed observer seems not to be commonly known. To be able thus to decoy coyotes (*Canis latrans*) offers many advantages to the observer or hunter as the case may be.

In February 1944, and within the period from August 1944 to May 1945, the writer, incidental to duty with the United States Fish and Wildlife Service, has decoyed a number of coyotes and a few lynx cats (*Lynx rufus*) to the vicinity of a blind that contained one or two persons. This was done by using one, or a combination of two, of three kinds of calls. For the purpose of this paper, these calls may be designated as the squeak-call, the howl-call and the distress-cail.

The squeak-call is made by forcing air into the mouth with the lips lightly closed or by placing the back of the hand against the lips and sucking air into the mouth. The noise thus created resembles the squeaking of a mouse. This squeaking noise is commonly used by ornithologists to decoy birds into a position where they may be watched or obtained for specimens.

Two coyotes were taken with the aid of this squeaking call on February 17, 1944, five miles south of Orovada, Humboldt County, Nevada, in the following manner: About 11:30 a.m. five coyotes were seen on a snow-covered field about 400 hundred yards from the highway. By crouching and walking, the edge of the field was reached without any of the coyotes becoming alarmed. I sat there, partly concealed, and repeatedly made a squeaking noise. Although the coyotes were about 400 yards away and traveling south, they turned east in response to the squeaking call and started trotting and running in my direction. The call was continued. When they had approached to within 100 yards a shot was fired and one male coyote fell dead. The remaining four separated and ran across the field. After covering about 40 yards one male stopped and looked back, then he was shot and killed. The others continued to run as I inexpertly shot at them twice more.

The howl call is high-pitched and can be made with the mouth. The aim is to imitate the howl of a coyote. For those whose voices are not suitable for making this call, a hand siren can be used.

This call has been used most successfully along with one of the other calls and is especially helpful in locating coyotes. After hearing this call, coyotes, especially in fall, winter and early spring months, often begin to howl or bark which reveals their location to the hunter, who can then approach closer and use the more effective distress call. Experience indicates that when coyotes bark, or bark and then howl, they usually have seen the hunter or have become alarmed. In either event further effort to decoy these animals usually is not effective.

One large, adult, male coyote was taken with the aid of the howl-call in the following manner: About 10:30 a.m. on October 12, 1944, two miles east of Weeks, Lyon County, Nevada, I left my car on a desert road, concealed myself near an open field about 200 yards north of the car and twice gave the howl-call

Immediately two coyotes began to howl. The deeper-voiced animal was the nearer to me and about 150 yards east of the other coyote. They were judged to be about one-fourth mile away. After about three minutes they were silent although I repeatedly gave the call. When five minutes had elapsed, a large coyote was seen trotting toward me; it stopped at the edge of the field and then continued to the middle of the field where it was about 100 yards from me where I shot it. It first came into view from the direction of the place where the deeper-voiced coyote was heard. It was a male that weighed 32 pounds. Its much worn teeth and the rugosity of its skull indicated that it was a very old individual.

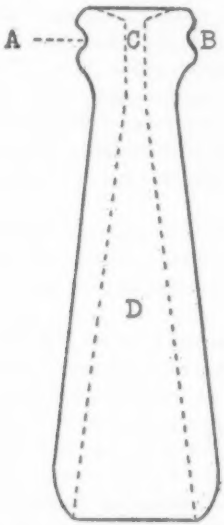

FIG. 1. Hand made call. Natural size. A strip of thin rubber, one fourth inch wide, cut from a surgical glove, is stretched across from notch A over top to B. It can be held securely with string or rubber band. Air blown into C vibrates strip of rubber that creates distress sound that passes through C and D. This device, made with wood, can also be made from the horn of a cow.

The distress-call is high-pitched and resembles the cry of a rabbit. The call is best made with one of three devices: (1) the "variable game call" manufactured by P. S. Olt; (2) the "hand-made call" (see fig. 1) of the type owned by Mr. Sidney O. Curtiss, a government trapper, of Wells, Nevada; (3) a call made from a horn of a cow. Any one of the three devices can be operated successfully by holding it between the thumb and index finger. The hand is closed over the free end, and suddenly opened when air is blown into the opposite end. In using the Olt device, Mr. Vernon L. Mills of Fallon, Nevada, regulates the tone by varying the amount of air forced into the device rather than by using his hand as described above. He gives the call from one to five times, then waits about 10 seconds

before repeating it. By this method he has decoyed a number of coyotes and a few lynx cats. Mr. Sidney O. Curtiss, on his hand-made device, rapidly blows 15 to 25 times, rests for 15 to 30 seconds, and then repeats the process. Originally he purchased his calling device from an Indian of Wells, Nevada, who taught him how to use it. Mr. Curtiss states that on one rainy day in November 1944 he took 12 coyotes by calling them to him and then shooting them with a 12 gage shotgun. He has decoyed also lynx cats and badgers (*Taxidea taxus*) to within 10 feet of him with this call.

In November 1944, in Churchill, Lander, Lyon and Esmeralda counties, Nevada, the writer made a total of 46 attempts to lure coyotes to him. Not less than 3 minutes nor more than 35 minutes were devoted to any one attempt. Two lynx cats and 24 coyotes were decoyed. Seven of these coyotes were shot. On the occasions when Mr. V. L. Mills was present, he assisted by using the distress call. November and December were the most successful months and selected information for each coyote thus obtained in November and December of 1944 is given in the following order: the writer's catalogue number, locality, date, sex, weight, estimated age, stomach contents, method of capture, and behavior of the animal.

4215.—2 mi. NE Roy Brown's Station, southwestern part of Lander County, Nevada, November 5, 1944; female, 29 lbs., old (teeth much worn and sagittal crest high); one freshly killed black-tailed jack rabbit (*Lepus californicus*) in stomach.

4216.—Same place and time as no. 4215; female, 22 lbs., about 18 months old (teeth unworn and sagittal crest low); stomach one-third full of black-tailed jack rabbit and one small mammal (possibly *Microtus*). Accompanied by Mr. Ray W. Thomas of Fallon, the car was stopped on highway U. S. 50 and three howl-calls given. Two or three coyotes to the west-northwest immediately answered. Then we walked to a sand hill about one-fourth of a mile nearer the coyotes and at 4:49 p.m. partly concealed ourselves on the ground. The distress call was repeatedly given and at 5:05 p.m. three coyotes were seen running toward us from about 50 yards away. Mr. Thomas shot no. 4215 with a shotgun when it was about 20 yards distant; the other two turned and ran. The writer shot one of these (no. 4216) when it was about 110 yards away.

4217.—2 mi. N Roy Brown's Station, Lander Co., Nevada, November 6, 1944; male, 30 lbs., approximately nineteen months old, two middle toes missing from right hind foot (toes conceivably lost in a trap); stomach about one-third full of remains of black-tailed jack rabbit. As we stepped from our car onto a knoll, the coyote was seen about 300 yards away. R. W. Thomas and I walked 50 yards toward the coyote, laid on the ground behind a knoll which had obscured the view of the coyote, and repeatedly gave the distress call. The coyote trotted toward us and stopped about 25 yards away where at 12:15 p.m. Mr. Thomas shot it with a 12 gage shotgun. We then walked to the coyote and after discussing the incident for several minutes, decided to conceal ourselves and give the call again. This was done and at 12:40 p.m. another coyote was seen

(about 30 yards distant) running away from us. It disappeared in a growth of brush.

4219.—20 mi. S Fallon, Churchill Co., Nevada, November 7, 1944; female, not weighed, old; one lizard (*Uta*) and a small amount of grass in stomach. Vernon L. Mills and I left the car on the highway and partly concealed ourselves about 200 yards away at 1:10 p.m. The howl-call was given three times and one coyote answered from the south. Then the distress call was repeatedly given and at 1:20 p.m. a coyote approached from the south to within 35 yards of us where it was shot with a shotgun.

4222.—7 mi. SSW Fallon, Churchill Co., Nevada, November 16, 1944; female, 22 lbs., approximately eight months old; stomach empty. Vernon L. Mills and I walked about one-fourth of a mile from our auto and at 4:03 p.m. seated ourselves in the shade of a large *Sarcobatus* brush near the crest of a small sand hill. Mills repeatedly blew distress-calls and this coyote trotted to within 25 yards of us where it was killed with a shotgun at 4:16 p.m.

4225.—5 mi. WSW Millers, Esmeralda Co., Nevada, November 21, 1944; male, 29 lbs., old; stomach full (hide and hair of *Odocoileus*) the contents weighing one pound. The distress call was repeated from 3:45 p.m. to 4:15 p.m. at which time, a coyote was seen standing about 100 yards to the west. It started to trot away and was killed with a rifle.

4227.—One mi. N Sand Springs, Churchill Co., Nevada, November 27, 1944; female, 23 lbs., old; stomach contained remains (4 ozs.) of black-tailed jack rabbit. Vernon L. Mills and I stopped our auto on the highway and three howls were given. One coyote to the north-west answered. On an old road, we drove north about one-half mile nearer the coyote and concealed ourselves about 50 yards apart, 300 yards north of the auto. Beginning at 12:10 p.m., Mills repeatedly blew the distress call for 10 minutes when the writer saw, and with a 12 gage gun shot at, a running coyote about 80 yards to the north-east. The coyote, still running, was killed about 250 yards away with the rifle. Tracks in the sand revealed that the coyote had run within 22 yards of me from the north-west, hesitated, and then ran northeast.

4230.—One mi. S of the south end of Lahontan Reservoir, Lyon Co., Nevada, December 6, 1944; female, 16 lbs., approximately eight months old (no visible wear on teeth and sagittal crest not high); stomach partly full (remains of black-tailed jack rabbit 60 percent and unidentified material 40 percent). The howl-call was given four times and no answer heard. The distress call was then repeated from 3:30 p.m. to 3:35 p.m. at which time one coyote approached from the east-southeast, half circled our position at a distance of about 20 feet, and became alarmed when 15 feet west. It ran northward about 50 yards and then west about 40 yards before it was killed with the rifle after a number of shots were fired from the shotgun and rifle.

4231.—6 mi. N Yerington, Lyon Co., Nevada, December 8, 1944; male, 22½ lbs., about 8 months old (teeth unworn); stomach contained cow hide and 15 roseberries (*Rosa* sp.). H. D. Lutton, a trapper of Yerington, Nevada, and I

partly concealed ourselves among boulders at the base of a small hill at 3:55 p.m. The howl was given five times and no answer received. Then the distress-call was repeatedly given and two magpies flew near us. At 4:20 p.m. a coyote was first heard, then seen, running about 20 yards away where it was killed with the 12 gage shotgun. Tracks showed that this coyote had approached to within 10 feet of me before it turned to flee.

4232.—6 mi. NW Valmy, Humboldt Co., Nevada, December 14, 1944; female, 24 lbs., 18 months or more old; stomach full (freshly killed black-tailed jack rabbit). Partly concealed by a bush of the buffalo-berry (*Shepherdia argentea*), I gave the distress call at 4:10 p.m. One marsh hawk (*Circus hudsonius*) and about 14 magpies (*Pica pica*) soon flew near me, seemingly in response to my call. At 4:27 p.m. footsteps were heard on the 2 inches of crusted snow that covered the ground. The coyote was first seen looking at, and trotting toward, me from 30 yards away, and she continued to within 6 feet. As I moved the shotgun the coyote turned and started to run north, but was killed when about 20 feet away.

4238.—8 mi. SSW Fallon, Churchill Co., Nevada, December 29, 1944; male, 27 lbs., approximately 8 months old (teeth unworn and sagittal crest low); stomach empty. At 2:10 p.m. I sat on the ground and was well concealed by brush. Repeatedly the distress was given. At 2:14 p.m. three coyotes were seen southeast about 21 feet from me. They were near each other, trotting toward me. I leaped to my feet and fired once with the shotgun as one coyote ran to the northwest and fired again at the one which ran to the northeast. By this time the third coyote was out of sight but examination of its tracks indicated that it had fled south-southwest. Thereupon I discovered that both of the coyotes that had been knocked down by my two shots had gotten up and were running away. One that ran northwest was found dead about 200 yards away, but the other, although trailed for about a half mile, was not found.

Behavior of other coyotes decoyed was much the same as described above although no attempt was made to shoot most of them. Some trotted, and others ran, to the vicinity of the blind. On discovering their error, they usually turned and with increased speed ran over the same area taken in approaching the observer.

This evidence shows that coyotes of all ages decoy with the aid of any one of three calls, the distress-call being the most successful.

Poor results were usually obtained on windy days. On several occasions coyotes approached to within about 80 yards of the blind on the down wind side. There, they apparently scented the occupants because the coyotes were seen to turn abruptly, hesitate momentarily when broadside, and then run away.

Certain birds were attracted by the distress-call. Magpies, ravens, and marsh hawks were the ones most commonly decoyed. Magpies frequently preceded the approach of a coyote.

So far as I know, information has not previously been published on the use of the distress-call or the howl-call. The use of these calls is recommended to any person interested in shooting, photographing, or studying coyotes.

U. S. Fish and Wildlife Service, Fallon, Nevada.

MAMMALS OF THE NORTHERN GREAT PLAINS ALONG THE INTERNATIONAL BOUNDARY IN CANADA

By J. Dewey Soper

The aim of this paper is to render an account of the native mammals that inhabit a relatively broad strip of territory along the International Boundary in Canada from southeastern Manitoba to the foothills of the Rockies. A work of this kind seems desirable as hitherto it has not been attempted. Except for the fact that the mountainous southwestern corner of Alberta is not included, the account is substantially that of the mammalian fauna found in the extreme southern part of all three Prairie Provinces. Consequently, the annotated list is preponderently composed of those species that are characteristic of the campestrian, or Great Plains, region. However, in the nature of things, a number of species are necessarily included from the Canadian Zone of southeastern Manitoba which do not come strictly within that category.

No definite northern limit can be assigned to the boundary area under review, but it may be taken, arbitrarily, as having a width of 10 townships, or 60 statute miles. Results are included from a few working localities as far distant as that from the United States border, but most collecting camps were within 20 miles, or less, of the latter line. Where it has seemed expedient to do so, a number of records have been admitted from points even somewhat farther north than the 60-mile-wide belt referred to above. The east-west length of the territory concerned is approximately 875 miles.

In this region, most of the writer's investigations were carried out in 1927 for the National Museum of Canada (Anderson, 1929, pp. 21–22). At that time comparatively little was known of the mammals along the border and few specimens from there had found their way into the national collections. It was to overcome this deficiency that these particular investigations were undertaken. Work was commenced southeast of Cardston, Alberta, in June and advanced to the east without interruption until November. Sixteen camps in all were established during the season at an average distance apart of about 40 miles. The last one at this time was situated on Turtle Mountain, Manitoba, where the prolonged inquiries were terminated with the onset of early winter.

Subsequently, much more mammal information was gathered along or near the 49th parallel. This was made possible at wide intervals while engaged in general faunal investigations for the Wild Life Division of the National Parks Bureau, Ottawa, from 1934 to 1944. The results were especially advantageous for the present purpose, as many gaps were filled in relation to the inquiries of 1927, not only west of Turtle Mountain, but also east of that point almost to the Ontario border—territory that had not been examined on the earlier expedition. Pertinent data, derived from all the investigations concerned from 1927 to 1944, are combined in the present paper: these are based on a total of about eight months of "boundary" field work, embracing approximately 12,000 trap-nights, and the collection of nearly 900 specimens of mammals.

In sequence, the present list follows Miller's (1924) *List of North American Recent Mammals 1923*. The scientific nomenclature is also derived from that work with the exception of a number of changes occasioned by more recent systematic research. Common names are largely adopted from Anthony's *Field Book of North American Mammals* (1928). The writer is greatly indebted to Dr. R. M. Anderson, National Museum of Canada, for the subspecific determination of the mammals collected and permission to use the 1927 records. All measurements are in millimetres in the order of total length, tail vertebrae, and hind foot. Weights, when available, are given in grams for the smaller mammals and in pounds for the larger ones.

NOTES ON THE PHYSIOGRAPHY

The initial physiographical division to be considered is that embracing the terrain of southeastern Manitoba from the Ontario boundary to the eastern escarpment of Pembina Hills. This extends through an east-west length of approximately 140 miles, most of which is referable to the first prairie steppe. The average elevation along the International Boundary is about 950 feet above sea-level. All of this area was formerly occupied by the post-glacial Lake Agassiz. East of Red River, to Ontario, the country is progressively more heavily wooded with such species as aspen, Manitoba maple, white birch, white spruce and white pine, together with black spruce and tamarack in muskeg areas. Considerable eastern influence is indicated by the occurrence of various species of trees, shrubs and animals which here reach, or nearly reach, their western limits of distribution. West of Red River to the base of the escarpement near Morden, the land is flat and practically treeless. Average yearly precipitation is about 20 inches.

Lying immediately to the west is the second prairie steppe with an average altitude of 1,775 feet. This stretches for a distance of 270 miles to the west where it terminates at the border of the Coteau de Missouri at about longitude 104° W. Roughly speaking, the eastern half of the territory comes within the parklands belt where much of the country is wooded. This is especially true of the Pembina Hills section and west to about Killarney; elsewhere the woodlands are chiefly in the form of scattered "bluffs" of aspen alternating with farmlands and prairie. These gradually diminish in size and abundance and finally disappear in the Glen Ewen district. The western portion of the steppe is treeless except along some of the streams, of which Souris River is the most important. The principal tree growth in such situations consists of aspen, green ash, Manitoba maple, white elm and burr oak. For the most part, the terrain is rather flat to gently undulating in character, but some sections are distinctly hilly. Mean annual precipitation varies from about 19 inches in the eastern part of the steppe to 15 inches in the western portion.

The most notable physical feature in this region is Turtle Mountain, Manitoba. Major elevations attain to around 2,500 feet, the average altitude above the surrounding plains being approximately 600 feet. In general, the topography is characterized by numerous hills and ridges of glacial origin, interspersed with a profusion of small lakes. Most of the plateau is well wooded with aspen, balsam

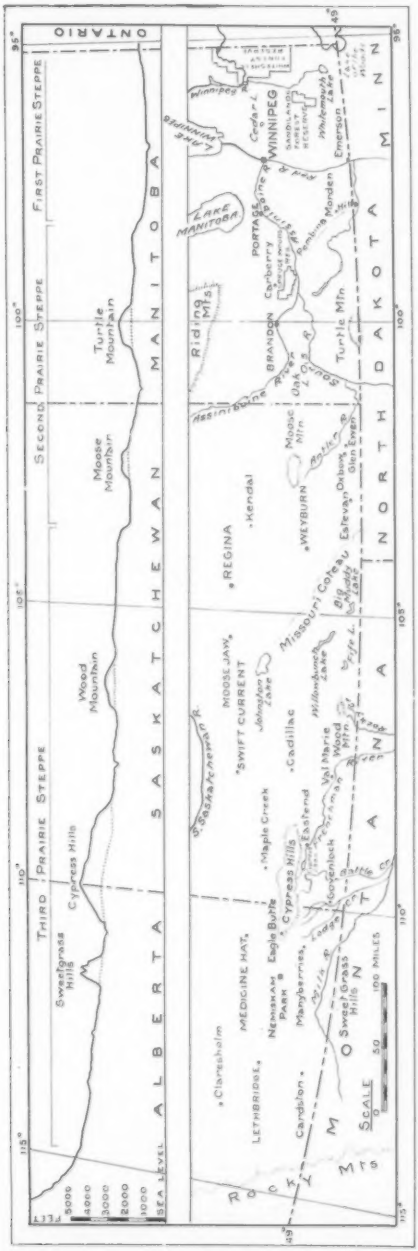

FIG. 1. Sketch map of the southern extremities of Manitoba, Saskatchewan and Alberta along the International Boundary. Upper portion of the sketch is a corresponding, diagrammatic profile of the same territory.

poplar, white birch, and many of the other deciduous trees already mentioned, but aspen predominates. Annual precipitation varies from 19 to 20 inches.

The final, main topographical and biotic division is represented by the third prairie steppe. This extends from a point about 20 miles east of Big Muddy Lake

PLATE 1

UPPER LEFT: Scene along Whitemouth River, Sandilands Forest Reserve, southeastern Manitoba, 40 miles north of the International Boundary. Canadian Zone. First Prairie Steppe.

UPPER RIGHT: Pembina River Valley, Pembina Mountains, near Mowbray, Manitoba, four miles north of the International Boundary. Eastern (Humid) Division of the Transition Zone. Second Prairie Steppe.

LOWER LEFT: Morgan Creek badlands, south of Wood Mountain, Saskatchewan, one mile north of the International Boundary. Dilute Upper Sonoran Zone conditions prevail in the bottomlands, while the Western (Semiarid) Division of the Transition Zone is represented on the high, surrounding plains. Third Prairie Steppe.

LOWER RIGHT: Chin Coulee, Nemiskam National Park, 25 miles north of Milk River, Alberta. Western (Semiarid) Division of the Transition Zone. Third Prairie Steppe. Floral and faunal conditions are typical of those existing over the greater part of extreme southern Alberta.

to the foothills of the Rocky Mountains through a distance of about 465 miles. In contradistinction to the prairie-agricultural country of the two preceding steppes, this higher terrain consists of typical ranching mesa, although extensive, local tracts are now devoted to dry farming. Precipitation is scanty (normally 15 inches or less a year) and, as a result, most of the vegetation is xerophilous in

character, typical of a semiarid region. Elevations range from about 2,500 feet at Big Muddy Lake, Saskatchewan, to 4,200 feet south of Kimball, Alberta. The whole of this southern portion of the third prairie steppe lies on the Missouri River watershed. Numerous sloughs and lakes occur, most of which are strongly alkaline.

Most of this vast plain, exclusive of badlands sections, is moderately rolling, but this state is interrupted at wide intervals by rounded ridges up to several hundred feet in height. One of the most outstanding topographical features of the region is the great Frenchman River Valley which heads near Cypress Lake and extends southeastwards to join the Milk River in Montana. At Eastend it provides an arresting spectacle with towering buttes and palisades rising to heights of 500 to 600 feet above the river. Eastward the valley is flanked by many tracts of arid badlands and deeply eroded coulees, the most prominent section occurring between Val Marie and the International Boundary. Other markedly rugged areas obtain south of Wood Mountain and irregularly eastward to Big Muddy Coulee and Lake.

The vegetational cover is chiefly of the shortgrass type in association with numerous species of small herbaceous plants. Considerable quantities of sagebrush, greasewood and cacti also occur in many localities. A few northward-facing slopes of the valleys support scattered patches of aspen, green ash, Manitoba maple, gooseberry and black currant, while occasional acclivities are scantily clad with juniper and bearberry. Parts of Wood Mountain are covered with stands of aspen and well developed shrubbery.

The plains of extreme southern Alberta are essentially similar to those already described for southwestern Saskatchewan, but there are a number of distinctions. These mainly arise from the circumstance that the mean altitude is substantially greater, that badlands areas are not so frequent or extensive, and that for the most part the valleys and coulees lack comparable development on a grand scale. As everywhere on the Missouri drainage to the east, the high plains are entirely treeless, but parts of the Milk River Valley are grown to dense thickets of willow, thorn and other shrubs, together with scattered stands of cottonwood. Other characteristic plants of the bottomlands include silverberry, snowberry, prairie rose and sagebrush, while occasional flats are occupied by greasewood. The prickly pear cactus is widely distributed, sometimes in marked abundance. Tree growth, consisting chiefly of aspen, is also found on the upper slopes of Sweet Grass Hills.

Over the plains, at large, climatic conditions are fairly uniform with only local variations in aridity. This does not apply, however, to the higher wooded hills and plateaus which rise like "islands" out of the Great Plains; on such eminences there is a pronounced difference in climatic, floral and faunal conditions. In Canada, the most notable of these insular tracts in the south is Cypress Hills. This plateau, situated astride the Alberta-Saskatchewan interprovincial boundary, covers an area of about 1,600 square miles and rises to a maximum height of 4,280 feet. Broad tracts of superior elevation, particularly in the western portion, are heavily forested with white spruce, lodgepole pine, balsam

and aspen. Elsewhere the uplands consist of brushy or open grassland areas. All of the lower slopes, benches and foothills are treeless and semiarid with much the same general character as the encircling plains below. Despite these adjoining conditions, tree and shrub growth is carried to much lower levels by way of a few major valleys, of which that occupied by Battle Creek is the most conspicuous example.

FAUNAL LIFE ZONES

Over a wide expanse of territory, such as that under review, it is to be expected that widely different types of environment prevail. In the present instance representative zonal conditions range all the way from dilute Upper Sonoran to Canadian. Each of the zones involved will be briefly discussed in succeeding paragraphs.

In some localities the merging of various elements tend to obscure the ecological picture and unless analyzed with care may easily lead to confusion. However, it is not always possible to assign a given area to any particular biotic division because of the blending which takes place between adjoining zones. Distribution of species is occasionally sharp and well-defined in relation to major zones, as well as peculiar habitat types, or biotic communities, within the zone. This is sometimes the case even in the more or less desert-like parts of the Missouri watershed where conditions are superficially similar over wide areas. An animal is not infrequently found occurring within peculiar and very narrow limits, occupying a habitat featured by rather fine physical distinctions. Other species, again, are much more plastic and while at their centers of abundance are entirely characteristic of the particular zone they occupy, they nevertheless overflow to some extent into adjacent areas where environmental conditions are quite different.

Many examples could be cited, of course, to illustrate this well known interzone distribution. Particularly notable is the situation created by Rocky Mountain influences which promote intergradations in far western Alberta and likewise eastern influences with respect to localities in eastern Manitoba, both of which extremes come within the scope of the present paper.

Upper Sonoran Zone.—In the writer's opinion, a dilute representation of this zone occurs in a few places on the Missouri drainage in southwestern Saskatchewan. It apparently exists nowhere entirely free from interfusion with the western or semiarid division of the Transition Zone. At best, it extends for only a relatively short distance north of the International Boundary where it is chiefly confined to the lower levels of deep valleys and coulees tributary to the Missouri River. The zone is most pronounced in the more southern part of Frenchman River Valley, but faint signs of its existence in this depression appear to reach as far north as Eastend; one of the best indicators is revealed in the presence of *Cymonys ludovicianus* on the valley bottomlands from near Val Marie southeastwards into Montana. Apparent evidence of this zone in weaker form is also found in the valley of Battle Creek south of Supreme, and in the badlands along Rocky and Morgan creeks south of Wood Mountain. Other typical mammals

include *Peromyscus leucopus aridulus*, *Perognathus fasciatus fasciatus*, *Sylvilagus nuttallii grangeri* and *Mustela nigripes*.

Western (Semiarid) Division, Transition Zone.—Aside from the very limited and dilute intrusions of the Upper Sonoran previously mentioned, the whole of the plains region (characterized by xerophytic vegetation) from the foothills of the Rockies to the eastern limits of the Missouri Coteau (long. 104° W.) is referable to the present zonal division. It is substantially similar throughout, though minor variations occur in respect to development and abundance of various plants and the occurrence and distribution of the wild life. The most marked departures, chiefly in the nature of intrusives and intergradations, are found along its western foothill limits; on the southern flank of Cypress Hills; and on the approaches to its eastern extremity. A few of the characteristic mammals are *Canis latrans nebracensis*, *Citellus richardsonii*, *Microtus pennsylvanicus insperatus*, *Lemmiscus curtatus pallidus*, *Peromyscus maniculatus osgoodi* and *Ondatra zibethica cinnamomina*.

Eastern (Humid) Division, Transition Zone.—This division (where the vegetation is mainly mesophitic in character) may be regarded as extending from the Missouri Coteau east to approximately longitude 96° 30′ W. in eastern Manitoba. The western extremity of the division is nowhere well defined along the International Boundary but the eastern margin of the third prairie steppe appears to present a logical line of demarcation. It must be stressed, however, that from the viewpoint of precipitation and the nature of the fauna and flora, the country eastward from the Missouri Coteau, to at least Estevan, is distinctly intermediate in character as between semiarid and humid divisions. Furthermore, this coalescence can be traced in a progressively diminishing degree even as far as the southwestern corner of Manitoba. Some of the characteristic mammals that may be mentioned are, *Sorex cinereus haydeni*, *Citellus franklinii*, *Microtus pennsylvanicus drummondii*, *Microtus minor*, *Peromyscus maniculatus bairdii*, *Thomomys talpoides rufescens*, *Geomys bursarius* and *Sylvilagus floridanus similis*.

Canadian Zone.—In the territory under review this boreal zone occurs in three widely separated areas, i.e., extreme southeastern Manitoba, Turtle Mountain and Cypress Hills. The first-named area is typical and comes within the great transcontinental Canadian Zone belt, while the other two are insular areas, surrounded by the Great Plains, where boreal conditions are chiefly induced by a substantial increase in altitude. A peculiarity of Turtle Mountain is the absence of conifers. The mammalian fauna is not identical in all three areas. As an example, *Eutamias minimus neglectus* occurs in southeastern Manitoba, but the form *E. m. borealis* is found on Turtle Mountain and Cypress Hills. Again, *Tamiasciurus hudsonicus hudsonicus* is the subspecies inhabiting the first-named area, while on Turtle Mountain it is *T. h. pallescens;* the species is absent from Cypress Hills. Space forbids making a detailed analysis of all the peculiarities of distribution involved in the three areas under discussion. Among other characteristic mammals of the zone, as a whole, are, *Sorex cinereus cinereus*, *Sorex arcticus arcticus*, *Lynx canadensis canadensis*, *Peromyscus maniculatus maniculatus* and *Erethizon dorsatum dorsatum*.

ACCOUNTS OF SPECIES

Condylura cristata (Linnaeus). Star-nosed Mole.—Not personally located at any point, but known to occur very sparingly in southeastern Manitoba. Seton (1909, p. 1137) states that specimens have been taken at Winnipeg; Miller (1924, p. 17) includes the southeastern part of the province within its geographical range; and V. W. Jackson (1934, p. 27) records one specimen from Pine Falls and three from Manigotagan. I have what appears to be a dependable record of its occurrence at Whitemouth, and L. T. S. Norris-Elye, Manitoba Museum, received an example in late March, 1944, from Falcon Lake, near the Ontario boundary.

Sorex cinereus cinereus (Kerr). Masked Shrew.—Moderately common in southeastern Manitoba, chiefly in the Canadian Zone. It has been taken at Whitemouth Lake; Marchand; Sandilands Forest Reserve; Cedar Lake; and Winnipeg. Average size of six specimens: 94.2—38.1—11.9; extremes, 92—37—11; 97—44—12. Two adults from near Marchand weighed 2.9 and 3.0 grams, respectively. This form intergrades with *S. c. haydeni* to the west.

Sorex cinereus haydeni (Baird). Hayden Masked Shrew.—I have not personally taken shrews of this species on the first prairie steppe west of Red River, but they doubtless occur there. Specimens will likely prove to be integrades with *cinereus*. The present form appears to be fairly well distributed on the eastern half of the second prairie steppe, but it was not secured at numerous points where trapping has been conducted. Ten specimens taken at Breadon, Max and Williams lakes, Turtle Mountain average 98.5—38.9—11.7; extremes, 92—40—11.5 and 105—40—12; weights of four of these were 3.8, 3.8, 3.9, and 4.2 grams, respectively. These seem best placed under *haydeni*, although they are noticeably larger and darker than specimens from the prairie-parklands country to the north and west.

Three examples collected at the junction of Antler and Souris rivers, Manitoba, average 90.0—32.3—10.3. A very pale specimen taken at Aweme, north of Treesbank, Manitoba, on January 15, 1944, measured 91—36—11.5, and weighed 2.6 grams; two others caught at the same time weighed 2.7 and 3.0 grams, respectively. I did not succeed in capturing this shrew on the second prairie steppe west of Souris River, nor does it appear to occur anywhere on the third prairie steppe immediately north of the International Boundary.

Sorex arcticus arcticus Kerr. American Saddle-back Shrew.—This form barely comes within the scope of the present review. It occurs chiefly in the Canadian Zone of eastern Manitoba, but ranges locally westward in the Transition to Delta, Lake Manitoba, and points north and northwest. In the extreme southeastern part of the province and along a line to the northwest, intergradation takes place with the slightly differentiated form *S. a. laricorum*. One specimen from Whitemouth River, south of Reynolds, Manitoba, and two from Delta measured, respectively, 110—40—14; 118—40—13 and 112—41—13 mm. These animals are apparently nowhere very common.

Sorex arcticus laricorum Jackson. Southern Saddleback Shrew.—Distributed in Manitoba from the extreme southeastern corner of the province westward on the first and second prairie steppes to at least the Brandon district and Turtle Mountain. On the north it meets the range of *S. a. arcticus*. Specimens from near Marchand, Carberry, Aweme, and Max and Breadon lakes, Turtle Mountain, have been referred to *laricorum*. Regarding this, in part, refer to Criddle (1929, p. 156) and Jackson (1928, pp. 70 and 72, and 1931, p. 163). Three specimens from Turtle Mountain average 114.3—40.6—14.4; two females from Marchand measured 121—44—13 and 123—44—13.5 and weighed 7.1 and 7.5 grams, respectively.

Sorex obscurus soperi Anderson and Rand. Plains Dusky Shrew.—C. H. Young, National Museum of Canada, took 13 specimens of this newly described shrew on the north slope of Cypress Hills, Saskatchewan, in 1926. On June 21, 1941, I collected a male (113—46—13.6 mm) at Middle Creek, a short distance south of Cypress Hills near the Alberta border. It was inhabiting a thicket of wild rose on the bank of the creek. John Lindner of Govenlock (near this same stream) informed me that he had caught two small, brown shrews in his cellar, which from the description and general probabilities makes it appear practically certain that they were *S. o. soperi*. All of this district south of Cypress Hills is entirely treeless, but with a little shrubbery along the creeks. The dusky shrew is a characteristic

mammal of the Rocky Mountains and its occurrence in the Cypress Hills region is particularly interesting in view of the fact that it appears to be absent from the wide expanse of intervening plains. This race was also found by the writer in Prince Albert National Park, Saskatchewan, and on Riding Mountain, Manitoba.

Sorex palustris palustris (Richardson). Richardson Water Shrew.—An apparently uncommon inhabitant of the Canadian Zone in eastern Manitoba. An example was taken at Red Rock Lake, Whiteshell Forest Reserve, May 24, 1943, which measured 163—69—20 mm; weight 23.5 grams. Criddle (1929, p. 156) records the species as very rare at Aweme, where it is found in a small larch swamp bordering Assiniboine River.

Microsorex hoyi hoyi (Baird). Hoy Pigmy Shrew.—The only records available for extreme southern Manitoba are those by Criddle (1929, p. 156, and 1932, p. 188) with respect to specimens collected at Aweme, together with a series from South Junction, which are ostensibly *hoyi*. *Microsorex* which I collected at Stony Mountain and Delta, Lake Manitoba, have been determined as *intervectus*. In all probability, the record by Seton (1909, p. 10) for Red River Settlement is referable to the latter subspecies.

Blarina brevicauda ssp. (Say). Large Short-tailed Shrew.—These animals range throughout southeastern Manitoba and irregularly west to Aweme and Turtle Mountain. Specimens have been personally collected at Whiteshell and Sandilands Forest Reserves; Fort Garry (Soper, 1944b); Douglas Lake, Spruce Woods Forest Reserve; and William, Max and Breadon lakes, Turtle Mountain. Average size of 27 specimens from all these localities is 127.1—26.3—16.1; extremes, 117—26—16 and 136—26—17. Mean and extreme weights of 17 examples: 21.7 (18.2—27.4) grams.

Myotis lucifugus lucifugus (LeConte). Little Brown Bat.—All of the region under review comes within the known range of this species, but unfortunately no specimens have been personally secured. Small brown bats thought to be *lucifugus* were seen at Winnipeg; Battle Creek, Saskatchewan; and at Deer Creek, north of Sweet Grass Hills, Alberta. Seton (1909, p. 1150) records a specimen taken at Poplar Point, Manitoba, and Criddle (1929, p. 156) lists it as rare at Aweme. Mr. J. W. Vickers informed me that a small bat, considered to be this species, was common about the forestry buildings at Max Lake, Turtle Mountain, during the summer of 1943; they all disappeared on, or about, September 12.

Myotis keenii septentrionalis (Trouessart). Trouessart Brown Bat.—In August, 1931, Criddle (1932, p. 188) obtained two of these bats from Mr. J. R. McPherson, Souris, Manitoba. This is evidently the first and only record of this mammal for the province.

Lasionycteris noctivagans (LeConte). Silver-haired Bat.—Once observed in the rural municipality of Fort Garry on May 24, 1937. Said by Seton (1909, p. 1167) to be commonly and generally distributed in Manitoba. It is referred to by Criddle (1929, p. 156) for the Aweme locality near Treesbank as, "Tolerably common; more so in late spring and early autumn". I have no records of its occurrence on the Great Plains to the west, although it doubtless occurs there as a migrant.

Eptesicus fuscus fuscus (Beauvois). Big Brown Bat.—Not personally observed. Seton (1909, p. 1178) refers to a specimen taken by R. Kennicott at Lake Winnipeg. Not listed by Criddle (1929) in the Aweme district.

Lasiurus borealis borealis (Müller). Northern Red Bat.—I collected one of these bats at Winnipeg on August 28, 1934, which measured, 115—45—10; ear 14. Listed by Seton (1909, p. 1184) as a summer visitant, with one specimen from Morden and two from Winnipeg. Criddle (1929, p. 156) refers to it as fairly common at Aweme.

Lasiurus cinereus (Beauvois). Hoary Bat.—Seton (1909, p. 1184) records specimens which were taken at Winnipeg, Morden, Carberry and Souris. Criddle (1929, p. 156) states that it is tolerably common at Aweme.

Ursus americanus americanus Pallas. Black Bear.—In the region embraced by this paper, the black bear continues common only in the Canadian Zone wilderness of eastern Manitoba, particularly in the sanctuary portion of Whiteshell Forest Reserve. In the early days it was plentifully distributed over most of southern Manitoba west to about Oak Lake and throughout Turtle Mountain. An occasional individual is still reported in the latter

area and in Pembina Hills. Criddle (1929, p. 156) remarks that a few are to be found in the Spruce Woods Game Reserve and along the Assiniboine River southeast of Brandon.

Procyon lotor hirtus Nelson and Goldman. Upper Mississippi Valley Raccoon.—Once ranged widely and rather commonly over southern Manitoba, but it is now rarely met with and in many districts has become exterminated. A few still exist in Pembina River Valley, Pembina Hills, Turtle Mountain, and north at least to the valley of the Assiniboine River east of Brandon to Spruce Woods Forest Reserve. According to information gathered in 1927, and again in the fall of 1943, the species appears to be commoner on Turtle Mountain than elsewhere in the southern part of the province. During the autumn of 1927, a farmer near Estevan, Saskatchewan, informed me that several raccoons had been taken in that district along Souris River and also at Long Creek. Nothing was seen or heard of the animal farther west.

Mustela erminea bangsi Hall. Minnesota Short-tailed Weasel.—This new subspecies (Hall, 1945b, p. 176) is more or less plentifully distributed in the Canadian Zone forest of extreme southeastern Manitoba and in the Transition Zone woods over many parts of the first and second prairie steppes west to the local southwestern limits of the aspen grove belt. The present subspecies evidently meets the range of *M. e. cicognanii* near the Manitoba-Ontario border and that of *M. e. richardsonii* a short distance north of Winnipeg. Short-tailed weasels are said to inhabit Turtle Mountain in some numbers, but I did not succeed in taking any specimens in that area. *M. e. bangsi* is apparently absent from large, local tracts of open country, such as the lowlands of extreme southern Manitoba on both sides of Red River and in the southwestern extremity of the province. Along the International Boundary I have no evidence of its occurrence west of Turtle Mountain, although it may occur in the wooded portions of the Antler River and Souris River valleys. Criddle took several specimens of *bangsi* in the Aweme (Treesbank) district (Hall, 1945, p. 178).

Mustela erminea invicta Hall. Little Rocky Mountain Weasel.—Hall's revision of the short-tailed weasels (1945 and 1945b.) introduces this additional new subspecies into the mammalian fauna of western Canada. It comes within the scope of this paper through its definitely know occurrence in the wooded territory of southwestern Alberta. While Hall (1945b., p. 177) indicates its range as covering practically the whole of southern Alberta north to about the latitude of Edmonton, there are huge tracts of semi-arid, treeless plains in the southeastern part of the province in which it is not likely to occur. So far as I know at present, there is no evidence to show that any short-tailed weasels inhabit a broad strip of treeless territory immediately north of the International Boundary in Canada from southwestern Alberta to southeastern Saskatchewan. A little farther north, however, it is apparent that some are found in the Cypress Hills of Saskatchewan and, in all probability, adjoining wooded parts of this range in Alberta. The subspecific identity of these animals has not been determined, but they are probably the present form.

Mustela rixosa rixosa (Bangs). Least Weasel.—In the late summer of 1927 I secured a male specimen of *rixosa* at Eastend, Saskatchewan, which measured 153—19—21. R. Elliott, who lives near the junction of the Antler and Souris rivers, Manitoba, informed me that a few occur in that locality, both in the river valleys and on the upper prairies. He had seen several that had been trapped in winter and two were also found under stooks of wheat while threshing. L. T. S. Norris-Elye, Director, Manitoba Museum, has kindly given me details regarding a number of specimens in that institution which were taken in Manitoba during 1942 and 1944; Carman, ♀, 177—27—20.5 and ♂, 188—27—22; Oak Lake, ♀, 167—24—22.5; Manitou, ♂, 184—30.5—20.5; and five miles west of Kaleida, ♂, 176—30—20. The last two specimens each weighed 56.8 grams.

During 1943 I secured three Manitoba specimens as follows: Near Treesbank, ♀, 167—36—19.1, weight 23.3 grams; Big Grass Marsh, ♂, 174—30—20.0, weight 34.7 grams; and Delta, Lake Manitoba, ♀, 230—45—30.5, weight 64.9 grams. Based on such evidence as is available, it would appear that this species was markedly more numerous in the period 1943-44 than for many years.

Mustela frenata longicauda Bonaparte. Long-tailed Weasel.—Ranges throughout the

boundary territory under review, from southern Alberta to the lowlands of Manitoba as far, at least, as Red River. The Manitoba Museum has a fine specimen taken at Winnipeg that measured 480—173—53; weight 374.4 grams. Through the course of many years I have seen numerous examples on the treeless plains of southern Saskatchewan and Alberta, as the animals have the habit, to some extent, of hunting at all times of the day. Specimens were collected at Milk River, near Writingonstone, and at Nemiskam, Alberta; Val Marie, Saskatchewan; and Max and William lakes, Turtle Mountain, Manitoba. Measurements and weights of these, in the above order, are: 445—150—51; 465—170—57, wt. 489.6 grams; 448—165—51; 456—160—54; and 425—139—51, wt. 403.2 grams. One taken at Turtle Mountain on November 1, 1927, is in full winter pelage. These animals occasionally, if not habitually, range deeply into heavily wooded country adjacent to prairies and shortgrass plains.

Mustela nigripes (Aud. and Bach.). Black-footed Ferret.—Of rare occurrence in southwestern Saskatchewan and southern Alberta. Seton (1925, pp. 567-568) refers to a record at, or near, Calgary, derived from D. G. Elliot's "Catalogue of Mammals of the Field Museum", 1907, p. 448. In the "Fourth Annual Report of the Department of Railways, Labour and Industries, Province of Saskatchewan, 1932", the Provincial Museum records the capture of one of these animals in Sec. 5, T. 2, R. 24, west of 2nd Meridian (9 miles west of Big Muddy Lake), which was presented to the National Museum of Canada. F. Dunk, Director of the Saskatchewan Provincial Museum, has kindly provided me with the following additional records of specimens taken in that province, which are now in the above museum: Four miles southeast of Regina, September 30, 1924; four miles southwest of Gergovia, December 20, 1931; Climax, January 6, 1933; five miles north of Expanse, winter 1932-33; three miles west of Grayburn, December 4, 1935; and Hazlet, early December, 1935.

Mustela vison lacustris (Preble). Hudson Bay Mink.—Continues fairly common in the coniferous forest zone of southeastern Manitoba where signs of its presence have been noted at Whitemouth Lake and at various streams and lakes in Sandilands and Whiteshell Forest reserves. It is presumably this subspecies which inhabits the marshes at the south end of lakes Winnipeg and Manitoba, where I have repeatedly seen their trails both summer and winter, but it is said by trappers that the animals taken here are noticeably paler than those from the Canadian Zone to the east. Criddle (1929, p. 156) lists this as the resident form at Aweme, where at that time it was "tolerably common". In this district the animal occurs chiefly along Assiniboine River, and at Douglas Lake, Spruce Woods Forest Reserve, where it was personally observed in June 1937.

In 1927, while working eastward from southwestern Alberta, no information regarding the occurrence of mink was obtained until arriving at Eagle Butte, Alberta. I was there informed by Howard Taylor that a few still existed at Elkwater Lake on the north slope of Cypress Hills. It was also gathered from ranchers that the animals were very sparingly distributed along the upper waters of Lodge and North Fork creeks, Alberta, and at Battle Creek, Saskatchewan, from north of Fort Walsh south to about the latitude of Cypress Lake. It was said that in the early days the animals were common in this district and also along cold, forested tributaries of Frenchman River to the east on the southern watershed of Cypress Hills.

No definite information was secured as to the presence of mink anywhere on the Great Plains to the east until Turtle Mountain was reached. Here the animals were said by the forestry officers to be fairly common about the numerous lakes of the plateau. While there in the fall of 1943, I was informed that their status continued about the same as in 1927. A few signs were personally noted at Breadon and Max lakes. No specimens were obtained on either occasion. There is a possibility that some of these southern records are referable to *M. v. letifera*, but until specimens can be obtained to settle the question they are placed under *lacustris*. In this connection, Bailey (1926, pp. 173-174) provisionally refers mink from the northern part of North Dakota (Pembina River, Turtle Mountain and Souris River) to the present subspecies.

Mephitis mephitis hudsonica (Richardson). Northern Plains Skunk.—This species appears to be rather generally distributed throughout the territory under review. How-

ever, it is undoubtedly more numerous on the first and second prairie steppes than in the semiarid region of the Missouri watershed farther west. In 1927, data regarding its occurrence were obtained along Milk River, Alberta; at Cypress Hills; Wood Mountain; Big Muddy Lake and along Souris River in southern Saskatchewan; and at Turtle Mountain, Manitoba. In the latter area the animals are particularly common; a male was collected at Lake William on September 26, 1943, that measured 666—205—87; weight 6¼ lbs. The species is fairly common in the country from this point east along the boundary to and beyond the southeastern extremity of the province.

Taxidea taxus taxus (Schreber). Common Badger.—In 1927, badgers were found relatively abundant in southern Alberta and southwestern Saskatchewan; individuals and dens were seen on numerous occasions over a very wide area. The animals were much more thinly distributed on the second prairie steppe east of the Missouri Coteau, where they became progressively scarcer to the east. During that season, no sign of them was detected in extreme southeastern Saskatchewan, or southwestern Manitoba, although a few were still known to occur in that region. The species was found most abundant in southern Alberta. Three females were collected at Milk River, southeast of Cardston which averaged 668—123—112; a large male taken near Pendant d'Orielle measured 880—150—114. Of late years the animals have become greatly reduced in numbers owing to the much higher prices offered for their pelts. Between 1934 and 1943, I have seen only a few scattered signs of the animals on the third prairie steppe (where they were common in 1927) and none on the first and second steppes in Manitoba and Saskatchewan.

Vulpes fulva regalis Merriam. Northern Plains Red Fox.—During the field season of 1927, no evidence was obtained regarding the occurrence of red foxes anywhere in the Great Plains region from southwestern Alberta to southwestern Manitoba. In later years numerous individuals or, their signs, have been seen in southern Manitoba from Whitemouth Lake and Sandilands Forest Reserve west to Turtle Mountain. In the latter district they are common, as is also the case in many other localities in the southern part of the province. Criddle (1929, p. 157) records the animal as very rare in the Aweme district, but since then it has become much more numerous. The species was notably on the increase after 1940 and by 1943 had become abundant in various southern Manitoba municipalities. Requests from many farmers were submitted that year to the provincial government to have a bounty placed on red foxes owing to their destruction of poultry.

Vulpes velox hebes Merriam. Kit Fox.—These animals were once common on the Great Plains of southern Alberta and southwestern Saskatchewan, but they are now nearly if not completely exterminated. In 1927 I obtained information regarding the species in Alberta only at Milk River, southeast of Cardston; here a rancher, John Harvey, assured me that a very few still existed in that district between the river and the International Boundary. It was also reported as extremely rare south of Altewan, and Wood Mountain, Saskatchewan. In recent years I have again travelled over most of that region and could obtain no information as to its continued existence; without exception, all ranchers and farmers with whom I have talked are of the opinion that the kit fox is now extinct over its former Canadian range. In primitive times it ranged east to the second prairie steppe in southwestern Manitoba (Seton, 1925, p. 565).

Canis latrans latrans Say. Northern Coyote.—These larger and darker "brush wolves" occur at least in the more or less heavily timbered country of eastern Manitoba where they are relatively numerous. It is not known with certainty where they begin to integrade with *C. l. nebracensis* to the west, but it is probable that this takes place somewhere on the second prairie steppe between Pembina Hills and the southwestern part of the province. The animals are fairly common over various parts of this territory and on Turtle Mountain. I have seen many individuals in this region which are unquestionably darker than typical *nebracensis* of the arid plains farther west and are obviously referable either to *latrans*, or to be regarded as intergrades between that form and *nebracensis*.

Canis latrans nebracensis Merriam. Great Plains Coyote.—Ranges in apparently typical form throughout the whole of the semiarid plains region from western Alberta to at

least the eastern limits of the Missouri Coteau. In all probability it also occurs eastward, with only slightly sub-typical characters, over the treeless or nearly treeless portion of the somewhat more humid second prairie steppe to southwestern Manitoba. During the summer of 1927 the animals were found well distributed over the above region, as a whole, but they were especially abundant in the country about Lodge and North Fork creeks, Alberta, and at Val Marie, Rocky and Morgan creeks, and Big Muddy Lake, Saskatchewan. Individuals that I have seen more recently on the second prairie steppe, between Estevan and the Missouri Coteau, appeared as pale as the coyotes which inhabit the arid plains on the Missouri watershed.

Canis lupus ssp. Gray Wolf.—An occasional wolf ranges onto the plains of southwestern Alberta from the Rocky Mountain wilderness areas to the west or southwest. From all accounts they were once well represented on the semiarid plains of southern Alberta and evidently southwestern Saskatchewan, but are now of very rare occurrence. John Harvey showed me the skin of a large wolf which he shot in 1925 on his ranch near Milk River, southwest of Cardston. At the present time, the animals are virtually exterminated in southern Alberta and Saskatchewan and southwestern Manitoba.

Timber wolves are still found in some numbers over much of the heavily timbered region of eastern Manitoba. They are apparently more numerous in the Whiteshell Forest Reserve than elsewhere, but they have been seen on various occasions as far south as Whitemouth Lake and east to the vicinity of Marchand. Criddle (1929, p. 157) speaks of the timber wolf as extremely rare in the Aweme district and remarks that a fine example passed through that section of the country in 1910 and was shot at Carberry. Occurrences in south-central Manitoba have been so rare over a long period of time that any strays that now appear create exceptional interest. One of the latest records is that of a large example which was shot near Manitou in the late fall of 1943, the skull of which is now in the Manitoba Museum. In the early summer of 1945 a breeding pair was discovered in the sandhills about 9 miles east of Aweme; the den was dug out and the five young pups secured by Mr. Stuart Criddle. One of these specimens was kindly given to the writer and two to the Manitoba Museum.

Felis concolor missoulensis Goldman (1943). Northern Cougar.—In 1927 I obtained but one record of occurrence in the Great Plains region east of the Rockies. Mr. Philip Lindner informed me that about 1912 a half-breed shot a cougar in the Cypress Hills near old Fort Walsh, Saskatchewan. This is the only instance of the kind that had come to his attention in this district after a residence of more than 30 years. The animal ranges sparingly through the foothills and mountains of western Alberta. For extreme southern Manitoba, Seton (1925, pp. 49–51) gives records of its occurrence at Plum Coulee, Swan Lake, Brandon and Oak Lake. There is an ostensibly reliable instance of one having been seen near Marquette, Manitoba, on February 5, 1942, which was shortly after recorded in the Winnipeg Tribune by Professor V. W. Jackson.

Lynx canadensis canadensis Kerr. Canada Lynx.—Still occurs in some numbers throughout the coniferous forests of eastern Manitoba, and sparingly on Turtle Mountain. It was formerly common in both of these districts and also in the area now known as the Spruce Woods Forest Reserve, but in the latter locality it has become very rare. Stray individuals are reported at wide intervals in the wooded portions of the second prairie steppe from Pembina Hills westward to points north of Killarney and Turtle Mountain. These are obviously wanderers from the latter district, or from tracts of Canadian Zone wilderness to the north. I have information from only two localities farther west. Ranchers and game wardens state that a few are still found in the heavily forested areas of Cypress Hills and, in 1927, I was informed that very rarely an example wandered into the fringe of woods along Milk River between Police Coulee and Writingonstone.

Lynx rufus rufus (Schreber). Bobcat.—It is evidently this form of bobcat that was occasionally met with in southern Manitoba. I have no recent records of its occurrence. Seton (1925, pp. 218–219) states that in 1914 it was found at Pembina, and LaRiviere, in Pembina Hills, and he also gives a record for Whitewood, Saskatchewan. Criddle (1929, p. 157) says that his only record for the Aweme district is based on an individual that was shot there in a tamarack swamp in 1908.

Lynx rufus pallescens Merriam. Pallid Bobcat.—In 1927 ranchers reported that a few of these animals haunted the wooded sections of Milk River and tributary coulees between Writingonstone and Police Coulee. It was said that, a few years before, two had been shot in the latter locality. Howard Taylor, of Eagle Butte, informed me that an occasional bobcat was taken in the heavy woods of Cypress Hills. In recent years I have not succeeded in securing any further information regarding its presence in that region, nor whether it occasionally wanders north across the 49th parallel on the Missouri watershed of extreme southern Saskatchewan.

Marmota monax canadensis (Erxleben). Canada Woodchuck.—Common in the Canadian Zone of eastern Manitoba and on Turtle Mountain. It occurs sparingly along Red River, but I have failed to observe it anywhere on the open Manitoba lowlands east and west of this stream. On the second prairie steppe, however, it is widely distributed in varying numbers west to about the margin of the aspen grove belt, and it is also found on Moose Mountain, Saskatchewan. I have no records of its presence along the International Boundary farther west. Measurements of three specimens taken at Lake Jessie, Winnipeg River (two of which are black) average, 525—130—74.

Citellus richardsonii richardsonii (Sabine). Richardson Ground Squirrel.—Ranges throughout the territory under review from Red River to the foothills of the Rockies. The only record that I have of its occurrence east of Red River is of a small colony observed 11 miles east of Emerson, two miles north of the border. The animals are very scarce on the southern lowlands west of Red River, but become locally common on the nearby second prairie steppe. Here, on the whole, the species progressively increases in numbers west to the Missouri Coteau and finally reaches its greatest abundance on the high plains of the Missouri watershed from the latter point to western Alberta. However, even in this territory where maximum numbers are reached, the animals vary greatly in abundance in different areas, being scarce in some and exceeding numerous in others. They range alike over the valley bottomlands and on the high, shortgrass plains. No apparent enmity was found existing between this species and the black-tailed prairie-dog; *richardsonii* was common in and about the colonies of the latter on the bottomlands of Frenchman River. Measurements of fourteen specimens collected at Milk River, Alberta, and at Val Marie, Prairie Dog Buttes, and Rocky Creek, Saskatchewan, average 270.9—72.7—44.1; extremes 260—60—43 and 325—80—47.

Citellus tridecemlineatus tridecemlineatus (Mitchill). Striped Ground Squirrel.—Occurs over a wide area in southern Manitoba and southeastern Saskatchewan on the first and second prairie steppes, and also on Turtle Mountain. My easternmost record is for a point near the west end of Whitemouth Lake. It is locally common on the lowlands east and west of Red River, but over extensive tracts it appears to be absent. Farther north the species is much more abundant in the semiwooded country about Winnipeg, and to the north and west. On the second prairie steppe, distribution is very spotty and relative abundance also varies greatly from place to place. Along the border, the species appears to become progressively scarcer on the plains beyond southwestern Manitoba; it was traced for certain as far west as Oxbow, Saskatchewan, and is said to occur at least to the vicinity of Estevan, if not farther. In this more western territory I have observed the animals only on the partially wooded flats along Souris River. Measurements of eight specimens taken in the Winnipeg district, near Cedar and Whitemouth lakes, and at Mowbray, average 280.7—95.9—40.1, with extremes of 257—67—38 and 300—110—41.

Citellus tridecemlineatus pallidus (Allen). Pale Striped Ground Squirrel.—Despite prolonged investigations on the southern plains, this form has not been personally encountered. I was informed by local residents that a few have been seen near Elkwater Lake and in semibrushy tracts on the south slope of Cypress Hills north of Thelma, Alberta. The late L. B. Potter once told me that the animals occur sparingly in the vicinity of Kealey Springs, Cypress Hills, 14 miles north of Ravenscrag, Saskatchewan. In memorandum (1934) R. M. Anderson writes: "The National Museum of Canada has specimens from Waterton Lakes National Park, Alberta, which are undoubtedly *C. t. pallidus*, as well as

specimens from Cypress Hills, Saskatchewan, which are probably the same form, although they are a trifle darker".

A rancher at Big Muddy Lake stated that a few inhabit that district, notably in a coulee extending northward to Salt Lake and in the lower part of Big Muddy Coulee. None was seen while working there in late September, 1927; if the animals actually occur, it appears almost certain that they had already hibernated by this date. It seems probable that any striped ground squirrels inhabiting this district, as well as the country east to Estevan, are intergrades between *pallidus* and *tridecemlineatus*, although I have no concrete evidence whatever of the former's occurrence east of Cypress Hills.

Citellus franklinii (Sabine). Franklin Ground Squirrel.—Widely distributed on the first and second prairie steppes of southern Manitoba. My easternmost records are for Sandilands Forest Reserve and Whitemouth Lake, and the westernmost (along the International Boundary), near the junction of Antler and Souris rivers in the southwestern part of the province. The species also occupies at least the north slope of Turtle Mountain as far as Max Lake. In most of this territory the animals are fairly common to abundant. Over extensive areas, however, they are either scarce or absent, such as on the treeless prairies west of Turtle Mountain and on the open lowlands immediately east and west of Red River, although they inhabit the wooded valley of this stream. Measurements of six specimens collected at Whitemouth Lake, Vivian, and in the Winnipeg district average 372.8—140.6—52.1; extremes 360—144—52 and 381—141—53. One individual weighed 511 grams.

Cynomys ludovicianus ludovicianus (Ord). Black-tailed Prairie-dog.—As I have published two papers concerning this species in Saskatchewan (1938a, pp. 290-300 and 1944, pp. 47-48) remarks here will be brief. The first authentic record of *Cynomys* in Canada was secured by myself in late August, 1927, when a small colony was discovered in Frenchman River Valley 5.5 miles northwest of Val Marie, Saskatchewan. In July 1937, a fairly large colony was located in the same valley about 7.5 miles southeast of Val Marie. During mid-June 1941 four additional "towns" of smaller size were discovered on the bottomlands of Frenchman River and Breed Creek, averaging 6.6 miles north of the International Boundary in approximate longitude 107° 24'W. These are the only habitations known with certainty to exist in the Great Plains region of western Canada. Conditions under which the species lives in the Frenchman River Valley are considered to be referable to the Upper Sonoran Zone, although of dilute characteristics. Average measurements of seven adults are: 381.7—81.6—62.3; extremes, 350—90—64 and 400—82—63. Five of these weighed as follows: 684—912—1026—1140 and 1368 grams. A juvenile taken on July 7, 1937, measured 273—60—55.

Eutamias minimus borealis (Allen). Little Northern Chipmunk.—In the extreme south, this form occurs on the second prairie steppe of Manitoba west to the Souris and Antler rivers in the southwestern corner of the province. It is moderately common over most of the wooded parts of this territory, including Turtle Mountain. I did not succeed in finding it anywhere along the border in southeastern Saskatchewan, although it is plentiful on Wood Mountain. The only other known area in which *borealis* occurs to the west is in Cypress Hills, where it is common in the heavily forested western portion, and in diminishing numbers along Battle Creek as far south as about latitude 49°29'N.

Measurements of ten late July adults from this region in both Saskatchewan and Alberta average 200.8—91.9—31.8; extremes, 200—85—31 and 215—100—32: ten subadults average 160.7—71.1—27.5; extremes 160—78—30 and 192—88—32. Five typical adult *borealis* from Mowbray and Turtle Mountain, Manitoba, and Moose Mountain, Saskatchewan, average 213.2—98.2—31.8; extremes, 210—100—31.5 and 220—100—33. Five late October adults from the junction of Antler and Souris rivers, Manitoba, average 212.4—94.8—31.4; extremes, 205—90—30 and 215—100—33. Howell (1929, p. 57) refers the latter examples to *borealis*. It may be pointed out, however, that the under side of the tails of these specimens is paler and more yellowish than in typical *borealis* (which is more reddish) and certainly suggests an approach to *E. m. pallidus*.

A female collected at Moose Mountain, Saskatchewan, on May 21, 1942, contained seven embryos 17 mm long and weighed 61.5 grams; two others taken at the same time weighed 42.6 and 50 grams, respectively.

Eutamias minimus neglectus (Allen). Lake Superior Chipmunk.—This form, formerly known as *jacksoni* (Anderson and Rand, 1943c, p. 134), is confined, in the region under review, to the Canadian Zone of eastern Manitoba. In suitable situations it is relatively common to abundant, being most numerous in the eastern portion of this area and scarcest along the western perimeter of its range adjoining the open lowlands 30 to 40 miles east of Red River. My westernmost, positive records are for the Cedar Lake-Vivian locality (due east of Winnipeg), but a few little chipmunks seen at Pine Ridge, 18 miles northwest, may be referable to this subspecies. Measurements of 14 adults from the southern part of Whiteshell Forest Reserve, Sandilands Forest Reserve, and Cedar Lake, average 207.7—92.7—31.8; extremes, 197—91—31 and 222—98—32. A male taken at Red Rock Lake on May 25, 1943, weighed 51.7 grams.

Tamias striatus griseus Mearns. Gray Eastern Chipmunk.—Distributed over portions of the first and second prairie steppes in southern Manitoba. I have records of its occurrence at Whiteshell Forest Reserve; Lake Jessie and Pine Falls, Winnipeg River; Oakbank; Pine Ridge; along Red River to Selkirk; Pembina Hills; Turtle Mountain; Rock and Louise lakes; Portage la Prairie; Treesbank, and points to the north. Measurements of five adults from Oakbank, Pine Falls, and Fort Garry average 241—103.6—36.2.

Tamiasciurus hudsonicus hudsonicus (Erxleben). Hudson Bay Red Squirrel.—The distribution of this and the following subspecies in southern Manitoba is by no means clear. Many specimens of intermediate character have been taken, as would be expected with a species so variable. Studies are being continued as more material comes to hand. For the present purpose, *hudsonicus* is regarded as the subspecies that occurs at least throughout the mixedwood forest of eastern Manitoba. The subspecific status of the red squirrels occupying the deciduous woods for a considerable distance to the west (including the Red River Valley) have not yet been determined to our complete satisfaction.

An extensive series of skins has been collected in the latter area, but for the present will be ignored. In the Canadian Zone to the east, 15 specimens of *hudsonicus* were taken at Whitemouth and Cedar Lakes; Marchand; and Whiteshell and Sandilands Forest Reserves. Measurements of these average 314—125—47.5; extremes, 305—120—45 and 338—140—51. One collected at Marchand in late October weighed 191.1 grams. In this territory the animals are fairly common, and in some localities, abundant.

Tamiasciurus hudsonicus pallescens Howell. North Dakota Red Squirrel.—This subspecies occurs on Turtle Mountain, Manitoba, and evidently farther to the north and east. As yet, its range has not been satisfactorily determined in the southern part of the province as a whole. On Turtle Mountain it seems to be nowhere common, and in many areas is apparently very scarce or absent. In early November 1927, three specimens were collected at Max Lake, and in late September 1943, after much hunting, three more were secured at Lake William. Measurements of these average 317.8—129—49.8; extremes, 305—125—50 and 330—135—51. The Lake William specimens weighed 181.1, 196 and 205 grams, respectively.

Sciurus carolinensis hypophaeus (Merriam). Merriam Gray Squirrel.—Has a very limited range in Manitoba, occurring chiefly in the heavily wooded valley of Red River. In some sections it is fairly common along this stream, as in North Kildonan, Greater Winnipeg. Two females were collected there on February 4, 1941, measuring 490—230—69 and 491—233—71, respectively. An individual was taken in the summer of 1940 by Harry Van Sickle at Lake Jessie, Winnipeg River, which he kindly forwarded to me as a flat skin without skull measurements, and data as to sex. The only other records in my possession concern two gray squirrels captured by P. Gebauer in June, 1943, nine miles west-northwest of Morris, one that I saw on January 22, 1944, along the south shore of Lake Winnipeg about 3 miles east of Red River, and two that were recently taken by Stuart Criddle on his ranch a few miles north of Treesbank.

Glaucomys sabrinus sabrinus (Shaw). Hudson Bay Flying Squirrel.—May be regarded

as generally distributed in the Canadian Zone section of eastern Manitoba. According to the testimony of a few trappers, foresters, and woodcutters with whom I have talked, the animals are not uncommon in at least some parts of that region. At present, no specimens are available from there and consequently the western limits of this form, in relation to *G. s. canescens*, have not been determined. However, it is almost certain to coincide approximately with the western limits of the coniferous-deciduous forest in the southeastern part of the province. *G. s. sabrinus* is the subspecies that occurs in adjacent areas of western Ontario (Snyder, 1938, pp. 171–72). Surber (1932, p. 62) states that in Minnesota it extends northwest at least as far as Lake of the Woods County.

Glaucomys sabrinus canescens Howell. Pale Flying Squirrel.—This is an animal of the southern prairie-parklands environment with type locality at Portage la Prairie. It appears highly probable that the eastern limits of its range are approximately the Red River Valley and adjacent timbered areas north to Lake Winnipeg. A broad tract of practically treeless terrain exists south of the Seine River and east of the Red, where flying squirrels are absent, and which undoubtedly represents the dividing line between the present subspecies and *sabrinus*.

G. s. canescens occupies the timber along the Assiniboine River, but is absent from the treeless lowlands south of this stream between Red River and the Pembina Hills escarpment. Its principal range in the province unquestionably embraces the wooded sections of the second prairie steppe from the latter point west to the limits of heavy tree growth. I have no positive evidence of its occurrence on Turtle Mountain, but Indians assured me that flying squirrels, which are presumably *canescens*, inhabit Moose Mountain, Saskatchewan. Seton (1909, p. 438) records specimens under *sabrinus* from Winnipeg, Morden and Carberry which are now clearly referable to the present form. The latter is listed by Criddle for the Aweme locality, where it is tolerably common. On January 22, 1944, I collected two specimens of *canescens* in heavy mixed woods near Poplar Point Lake, three miles south of Lake Winnipeg; these are: ♂, 292—128—40, weight 156.6 grams, and ♀, 302—130—40.5, weight 171.4 grams.

Thomomys talpoides rufescens (Wied). Dakota Pocket Gopher.—Practically the whole of extreme southern Manitoba comes within the range of this animal. It is apparently absent from the Canadian Zone territory in the far eastern portion, and occurs only rarely on the extensive open lowlands between the latter and Red River. In the same type of country west of the river it is locally common, especially in the south, but there are hundreds of square miles in which it does not occur. The animal is widely distributed over the second prairie steppe west to about Glen Ewen, Saskatchewan, and it also sparingly inhabits Turtle Mountain. Measurements of 14 specimens from La Broquerie; Rineland; Mowbray; Louise, Douglas and Oak lakes; and Turtle Mountain, Manitoba, and Glen Ewen, Saskatchewan, average 221.2—65.4—30.4; extremes, 182—51—28 and 242—70—32. Five of these specimens which were weighed averaged 140.3 grams, with extremes of 117 and 153.7 grams.

Thomomys talpoides bullatus Bailey. Sagebrush Pocket Gopher.—One of the rarest of the mammals inhabiting the Missouri watershed in southwestern Saskatchewan. I have never detected the presence of these animals in extreme southeastern Alberta. In Saskatchewan I have records of their occurrence only at Dollard, Ravenscrag and Eastend. In late August, 1927, I collected four females in the latter locality with the following measurements: 195—55—27; 180—54—27; 200—65—30; and 205—62—29. There are 12 specimens in the National Museum of Canada, from the Cypress Hills, which have been referred to the present subspecies.

To the northward, *bullatus* evidently intergrades with *T. t. andersoni* and theoretically, at least, with *T. t. rufescens* to the east, but a wide territorial hiatus apparently exists between Dollard and Glen Ewe, Saskatchewan, where I have never succeeded in finding any signs of these animals.

Thomomys talpoides andersoni Goldman. Anderson Pocket Gopher.—The type locality of this subspecies is located at Medicine Hat, Alberta (see Goldman, 1939). I have never succeeded in finding any gophers in the far southern part of this province, but in 1927, a

rancher at Milk River assured me that he had seen pocket gopher mounds near Ash's Ford, west of Writingonstone. The animals involved were locally called moles. R. M. Anderson informs me that the National Museum, Ottawa, has two specimens of *andersoni* from the Milk River Ranch in Sec. 30, T. 2, Range 9, west of the 4th meridian; these were taken by Dr. L. S. Russell in September, 1934. This point of capture is not far east of the place where the record of occurrence was secured in 1927, as mentioned above.

Geomys bursarius (Shaw). Mississippi Valley Pocket Gopher.—This species was definitely added to the Manitoba list when specimens were collected on May 15, 1943, two miles north of the border, 11.5 miles eastwardly from Emerson (Soper, 1944a, pp. 71–72). Workings assumed to belong to *bursarius* were seen from a point near Emerson, east for about 20 miles, or to within 11 miles of the Roseau River; the width of this area of occupation appears to be no more than three or four miles—the only place in which the species is known to occur in Canada. In view of the above occurrence it was thought that *bursarius* also inhabited the similar type of lowlands west of Red River, but trapping at several points yielded only *T. t. rufescens*. Measurements of 10 adults, both sexes, average 272.7—83.6—35.2; extremes, 241—72—33.5 and 298—86—36.5; average weight, 253.3 grams, with extremes of 220 and 343 grams.

Perognathus fasciatus fasciatus Wied. Maximilian Pocket Mouse.—Known to occur locally in the southwestern portion of Manitoba where four specimens were taken at Aweme and the junction of Antler and Souris rivers; these measured: ♀, 143—67—18; ♀, 125—57—16.5; ♀, 135—64—17; and ♂, 128—63—16.3. The last specimen weighed 9.9 grams. The National Museum, Ottawa, has two specimens collected by H. M. Laing at Oak Lake, Manitoba, August 9, 1921. The species is assumed to range along the southern border of southeastern Saskatchewan west to the Missouri Coteau, since Bailey (1926, p. 119) records it in North Dakota as far northwest as Crosby. However, it must be extremely scarce in the adjacent Saskatchewan territory, as extensive collecting there has failed to take a single specimen.

Dipodomys ordii terrosus Hoffmeister. Montana Kangaroo Rat.—Of rare and sporadic occurrence in southwestern Saskatchewan and southeastern Alberta. This conclusion is supported by the fact that after trapping operations involving thousands of trap-nights in this region, not a single example has been personally collected; nor have any burrows been seen attributable to this species. The only information in my possession is from R. M. Anderson (memo. Dec. 4, 1937), who says: "I have three records of kangaroo rat in Canada, the first from near Medicine Hat, Alberta, in 1931; the second from Shackleton, Saskatchewan, in 1933; and the third from near Tompkins, Saskatchewan, in 1934".

Castor canadensis canadensis Kuhl. Canadian Beaver.—Locally distributed on the first and second prairie steppes from eastern Manitoba to Long Creek and Souris River in the Estevan district, Saskatchewan. The western limits of occupation on these streams is not known, nor precisely where intergradation begins to take place with *C. c. missouriensis* of the arid plains farther west. *C. c. canadensis* is most abundant in the Canadian Zone of eastern Manitoba. It is now absent from large areas to the west where it was formerly abundant, but is still known to occur sparingly at a few points in La Salle and Assiniboine rivers; Pembina Hills; Spruce Woods Forest Reserve; Turtle Mountain; and along Souris and Antler rivers in the southwestern corner of the province.

Castor canadensis missouriensis Bailey. Missouri River Beaver.—In Canada, typical *missouriensis* is confined to the high, arid plains of the third prairie steppe in southwestern Saskatchewan and southern Alberta. Personal records of occurrence embrace the following localities: Milk River, north of Sweet Grass Hills; Cypress Hills; Lodge, North Fork, Middle, Battle and Little Frenchman creeks; Frenchman River northwest of Val Marie and near the International Boundary; and Morgan and Rocky creeks, south of Wood Mountain. No beavers were found east of the last point on the Missouri watershed. A male taken at Battle Creek, Saskatchewan, on August 13, 1927, measured, 1040—340—180, and weighed 37.5 lbs. Three immature males collected at Rocky Creek on September 14–15, 1927, measured and weighed as follows: 730—265—135, wt. 13 lbs.; 735—260—140, wt. 14.5 lbs.; 735—250—135, wt. 13.5 lbs.

Onychomys leucogaster leucogaster (Wied). Maximilian Grasshopper Mouse.—Ostensibly occurs in southern Manitoba from near Red River to the southwestern part of the province, exclusive of Turtle Mountain and perhaps the greater proportion of Pembina Hills. For the most part, the animals must be extremely scarce because, despite intensive collecting at numerous points within this territory, I have never succeeded in taking a single specimen. Inclusion of the Manitoba lowlands west of Red River, in the above postulated range, is based on the fact that Bailey (1926, p. 82) mentions that a specimen was taken at Pembina, which is close to the Canadian boundary. Seton (1909, p. 485) also states that "Dr. Coues found it in the Red River Valley along the 49th parallel. Vernon Bailey reported it at Bottineau [North Dakota] on the west slope of Turtle Mountain". Criddle (1929, p. 158) has collected specimens at Aweme, Manitoba, and the National Museum, Ottawa, has one from Oak Lake, Manitoba, taken by H. M. Laing on July 16, 1921.

Onychomys leucogaster missouriensis (Aud. & Bach.). Audubon Grasshopper Mouse.—This form is distributed on the western portion of the second prairie steppe of southeastern Saskatchewan and on the high plains to the west. In consideration of the rarity with which specimens are taken, the animals may be regarded as thinly dispersed and perhaps of highly localized occurrence. I have collected specimens at only two points in Saskatchewan—near Kendall, and in the Frenchman Valley about eight miles southeast of Val Marie. These are all females and measure 118—31—21; 117—32—20.5; and 132—33—20, respectively. Banfield (1941, p. 121) collected one specimen at Cypress Hills, Saskatchewan. R. M. Anderson informs me that the National Museum of Canada has specimens from the region as follows: Saskatchewan.—three taken by Wm. Spreadborough at Indian Head, May, 1892, and one at The Holes, June 21, 1895; two from South Arm, Last Mountain Lake, by C. H. Young, July–August, 1920. Alberta.—two from Little Sandhill Creek, Red Deer River, by Joseph Skillen, July, 1919.

Peromyscus maniculatus maniculatus Wagner. Hudsonian White-footed Mouse.—The range of this subspecies, in the territory concerned, is restricted to the Canadian Zone of eastern Manitoba. Material has been collected in the Whiteshell and Sandilands Forest Reserves; at Lake Jessie and Pine Falls, Winnipeg River; Cedar and Whitemouth lakes; and Marchand. Measurements of 19 specimens average 182.9—88.4—20.5; extremes, 163—83—20 and 195—100—22; average weight of seven examples, 23.5 grams, with extremes of 16.2—28.1 grams.

Peromyscus maniculatus bairdii (Hoy & Kennicott). Baird White-footed Mouse.—Found in southern Manitoba from Red River over a broad belt of parkland-prairie country to eastern Saskatchewan, including Turtle Mountain. On the east it meets the range of *maniculatus*, and on the west, *osgoodii*. Intergradation with the latter can be clearly traced all the way from Oak and Pelican Lakes, in Manitoba, to McDonald Lake near Estevan, Saskatchewan. Absolutely typical, dusky examples (sometimes occurring among *osgoodii* intergrades) are not found much farther west than longitude 100°.

Typical or only slightly subtypical examples have been collected in the Red River Valley; at Winnipeg; south end Lake Manitoba; Stony Mountain; Mowbray; Spruce Woods Forest Reserve; Aweme; Rock, Louise, Pelican and Oak lakes; Turtle Mountain; and the junction of Antler and Souris rivers. Some specimens even west of here are strongly suggestive of the present form; consequently, geographical and individual variation creates a puzzling situation over a longitudinal distance of fully 150 miles where it is often difficult, or impossible, to assign certain specimens to either the present form, or *osgoodii*. Measurements of 27 adults and subadults from the above mentioned localities average 155.6—63.1—19.2; extremes, 148, 60, 18—167, 70, 20. Weights of 19 specimens average 23.7 (19.1—27.2) grams. Two females taken at Louise Lake, Manitoba, on June 16, 1937, contained 6 and 7 embryos, respectively, having a mean length of about 8 mm.

Peromyscus maniculatus osgoodii Mearns. Osgood White-footed Mouse.—This pale-colored subspecies is an animal of the dry, southern plains; it ranges more or less abundantly in typical form on the third prairie steppe through a distance of about 450 miles from the foothills of the Rockies to the eastern limits of the Missouri Coteau. East of this point, on the second prairie steppe, an almost insensible intergradation takes place with the darker eastern

form *bairdii*. In fact, an occasional individual exhibits the first subtle approach to the latter form even as far west as Big Muddy Lake. However, it appears advisable to assign specimens to *osgoodii* as far east as about Glen Ewen. Beyond this, recognizable intergrades occur well into Manitoba (Oak and Pelican lakes), but *bairdii* characters are increasingly dominant east of longitude 102°W. In this connection see remarks under the preceding form.

Material that has been definitely assigned to *osgoodii* was collected in the following localities: Milk River from southeast of Cardston to longitude 111° 30′ W.; Nemiskam National Park; Eagle Butte, Cypress Hills; and Lodge Creek, Alberta. Battle and Middle creeks; Cypress Lake; Eastend; Val Marie, and along Frenchman River to the International Boundary; Fife Lake; Rocky Creek; Big Muddy Coulee and Lake; McDonald Lake; Estevan; and Glen Ewen, Saskatchewan. Between 1927 and 1942, 168 specimens were preserved from the above points. Of these, 148 have been selected as representing adults, the minimum length being arbitrarily set at 140 mm; measurements of these average 154.9—63.3—19.7; extremes, 140—54—19 and 175—73—20.4. Average weight of 20 adults, 22.3 grams; extremes, 18.5 and 26.8 grams.

Peromyscus leucopus aridulus Osgood. Badlands White-footed Mouse.—Chiefly an Upper Sonoran Zone form that is undoubtedly confined, in western Canada, to the high plains and badlands of the Missouri watershed. It appears to be comparatively rare because thousands of trap-nights produced only a few examples. In relation to *P. m. osgoodii*, on the basis of collected specimens, the ratio is approximately as 1 to 12. Prolonged trapping at many points well within its indicated range has failed to secure any *aridulus* whatever. Collectively, I have taken 18 specimens in the following localities: Milk River, southeast of Cardston and north of Sweet Grass Hills; Eagle Butte; and Lodge Creek, Alberta. Eastend; Rocky Creek; and Big Muddy Lake, Saskatchewan. Measurements of these average 169.1—70.9—20.6, with extremes of 155—62—20 and 187—85—21.

Neotoma cinerea cinerea (Ord). Gray Bushy-tailed Wood Rat.—Not personally seen or collected in the region under discussion, but signs of it were observed in crevices of sandstone exposures along Milk River north of Sweet Grass Hills. Harry A'Dett, a rancher in this locality, informed me that wood rats inhabit the sandstone outcrops along the partially wooded coulee of Police Creek and Henry Webster also stated that he had killed these animals at his ranch on Deer Creek.

Synaptomys borealis smithi Anderson and Rand. Smith Lemming Mouse.—Occurs sparingly in the Canadian Zone of eastern Manitoba. In 1929, Stuart Criddle collected several examples of this new subspecies (see Anderson and Rand, 1943a) near the Dawson Cabin, northern part of Sandilands Forest Reserve, and Green (1930) took specimens near Pine Falls, Winnipeg River, which may now be regarded as unquestionably referable to the present form.

Synaptomys cooperi cooperi Baird. Cooper Lemming Mouse.—This species ranges westward from Ontario as far, at least, as Sandilands Forest Reserve and Pine Falls, Winnipeg River, Manitoba. It has been taken at these two points by Criddle and Green, respectively; see references under preceding species.

Clethrionomys gapperi ssp. Red-backed Vole.—Voles of this genus from the Canadian Zone of eastern Manitoba have not, as yet, been satisfactorily determined, but they appear to approach closely *C. g. hudsonius* Anderson. They are locally abundant. I have collected examples at Whitemouth Lake; Sandilands and Whiteshell Forest Reserves; Lake Jessie and Pine Falls, Winnipeg River; and Cedar Lake. Measurements of 18 specimens from these points average 125.1—35.2—18.6; extremes, 120—35—19 and 158—46—20.

Clethrionomys gapperi loringi (Bailey). Loring Red-backed Vole.—A subspecies of the Transition Zone which is commonly distributed in wooded areas of the first and second prairie steppes from about Red River Valley to Glen Ewen, and perhaps Estevan, Saskatchewan. It is also numerous on Turtle Mountain. The animals were detected nowhere on the plains of the Missouri watershed except at Eastend and along the upper waters of Battle Creek, Saskatchewan, and near Eagle Butte, Cypress Hills, Alberta. They are fairly abundant over the wooded and brushy parts of the latter plateau, and under shrubbery in many draws

and coulees leading southward into the semiarid plains. Over the above territory, as a whole, 87 specimens have been collected in the past 18 years; 46 of these, 130 mm, or more, in length, have the following average measurements: 139.3—36.5—18.5; extremes, 130—32—17.5 and 164—45—20; 18 had a mean weight of 24.4 (20.9—28.5) grams. A female collected at Rock Lake, Manitoba, on May 14, 1942, and weighing 24.9 grams, contained 6 embryos averaging 15 mm in length.

Microtus pennsylvanicus insperatus Allen. Badland Meadow Vole.—This form is restricted in Canada to the semi-arid plains of the third prairie steppe in southeastern Alberta and southwestern Saskatchewan. At many, if not most, points in this territory, it intergrades with *M. p. drummondii;* specimens have been taken even as far south as the International Boundary which cannot, with certainty, be referred to one form or the other. However, over most of the treeless plains region drained by Milk River and its tributaries, the majority of specimens are obviously referable to *insperatus*. Examples determined as belonging to this subspecies have been collected along Milk River and at Nemiskam National Park, Eagle Butte, and Lodge Creek, Alberta, and at Middle and Battle creeks, Cypress Lake, Frenchman River (Val Marie and International Boundary), Fife Lake and Rocky Creek, Saskatchewan.

At many points the animals were scarce, or absent, but in a few localities they were found in comparative abundance. Measurements of 33 specimens from the above localities average 157.3—42.2—20.1; extremes, 130—36—19 and 174—49—21. Weights of 9 examples average 39.4 (28.8—53.1) grams. Two females, each bearing 6 embryos, were taken at Battle Creek near Supreme, Saskatchewan, on June 21, 1942; one weighed 44 grams with embryos 16 mm in length and the other 45.5 grams, with embryos 7 mm long. For further information regarding this subspecies see Anderson (1943), and Rand (1943).

Microtus pennsylvanicus drummondii (Aud. & Bach.). Drummond Meadow Vole.—More or less commonly distributed throughout the whole of the geographical area under review, ranging altitudinally from about 700 feet in the east to over 4,000 feet in the west. Diversity of habitat is also remarkable, ranging from the heavy coniferous woods of the Canadian Zone to the shortgrass-sagebrush plains of the Upper Sonoran Zone. All specimens taken east of the Missouri Coteau have been referred to *drummondii*, although material may yet be collected along the southern border of Manitoba, east of Red River, that will prove to be nearer to *M. p. pennsylvanicus* than the present form.

On the Missouri drainage of the third prairie steppe, *drummondii* is subtypical and nearly everywhere exhibits more or less intergradation with *insperatus*. On the whole, characters of the latter form are dominant from the area south of Wood Mountain, Saskatchewan, west to Milk River, Alberta, while intergradation with *drummondii* is notably pronounced along the western and southern flanks of Cypress Hills (Eagle Butte, Lodge Creek and Cypress Lake), as well as in some localities farther south and southeast. Over most of this territory, geographical and individual variation is so marked and complicated that it is impossible to assign some specimens to one form or the other. From the region under discussion I have collected 90 specimens which have been determined as *drummondii;* 72 of these having a length of 130 mm, or more, have been segregated as adults and subadults, the average measurements of which are 148.5—40.8—19.6; extremes, 131—30—18 and 170—42—20. Average weight of 10 specimens is 35.5 (26.3—49.4) grams. The heaviest example here listed, a female taken at Rock Lake, Manitoba, on May 14, 1942, contained 8 embryos with a mean length of 20 mm.

Microtus longicaudus vellerosus J. A. Allen. Northern Long-tailed Vole.—I have taken only two specimens of this vole east of the Rocky Mountains—the first at Milk River, north of Sweet Grass Hills (♂, 213—76—22); the second at Eagle Butte, Alberta (♂, 154—43—19). These examples are larger and paler than the typical form (see Anderson and Rand, 1944, pp. 20-21).

Microtus minor (Merriam). Little Upland Vole.—In the boundary zone, this little vole is distributed from the Manitoba lowlands, a short distance east of Red River, west to Big Muddy Lake, Saskatchewan, thus occurring on all three prairie steppes. While its distribu-

tion appears to be somewhat spotty, it is locally abundant on parts of the first two steppes as far west, at least, as the Estevan district. It is very scarce at Big Muddy Lake—the western limit of its range near the International Boundary as presently known. Within the territory as here circumscribed, I have collected specimens at, or near, Ridgeville, Winnipeg, Lake Louise, Aweme, and forks of the Antler and Souris rivers, Manitoba; and at Glen Ewen, and McDonald and Big Muddy lakes, Saskatchewan. Measurements of 54 specimens from these localities average 129.1—31.4—16.1; extremes, 110—22—15 and 147—39—17.5. Average weight of 9 examples was 23.7 (20.4—30.3) grams. Three juveniles taken near Ridgeville, Manitoba, on May 16, 1943, weighed 8.1, 8.3, and 9.2 grams, respectively.

Lemniscus curtatus pallidus (Merriam). Sagebrush Vole.—With few exceptions, this pale and highly distinctive vole is confined in Canada to the arid lands of the third prairie steppe lying on the Missouri drainage. It was formerly regarded as rare, but since I secured the first Canadian specimens taken by trapping, in early August 1927, the animals have been found in numerous localities from southeastern Alberta to Big Muddy Lake, Saskatchewan (Soper, 1931). They usually occur in colonies of varying size (almost invariably in association with clumps of sagebrush) and sometimes in marked abundance.

Material has been collected at the following points: Lodge Creek, Alberta. Middle and Battle creeks; Cypress Lake; Eastend; Frenchman River (6 and 11 miles N.W. of Val Marie, Prairie-dog Buttes, and International Boundary); Rocky Creek; Fife Lake; Big Muddy Coulee (10 miles S.E. of Willowbunch Lake); and Big Muddy Lake, Saskatchewan. A total of 65 specimens was preserved; 50 of these exceeding 100 mm. in length have the following average measurements: 121.6—19.5—17.5; extremes, 103—17—17 and 135—27—19.5. Weights of 10 individuals in this category averaged 33.4 (21.6—49.1) grams. A female, weighing 49.1 grams, collected near Val Marie on June 14, 1942, contained 8 embryos averaging 18 mm in length; another taken near Supreme on June 19 and weighing 48.5 grams carried 6 embryos with a mean length of 22 mm. Measurements of 5 immatures secured in the same place, on June 19 and 20, averaged 95.2—17.6—16.3, with a mean weight of 13.7 grams.

Ondatra zibethica ssp. (Linnaeus). Muskrat.—The form inhabiting the lakes and streams of the coniferous forest belt in southeastern Manitoba is not known, as no specimens are available. It is thought, however, to possess chiefly the characteristics of *O. z. alba*, perhaps showing intergradation with *zibethica* in the extreme southeast corner. Living examples which I have seen in the above territory are definitely darker than *cinnamomina* of the prairies and plains farther west.

Ondatra zibethica cinnamomina (Hollister). Great Plains Muskrat.—Ranges well north of the International Boundary from about Red River, in the east, west to southern Alberta. In addition to the Great Plains proper, it also occurs on Turtle and Wood mountains and Cypress Hills; also, it is thought to be this form that occupies Moose Mountain. The animals are well distributed over the territory at large, often occurring commonly in streams, lakes and sloughs even on the high, arid plains of the Missouri watershed. Specimens referred to *cinnamomina* have been collected at Lodge Creek, Alberta; Battle Creek, Eastend, Val Marie, Rocky Creek, Fife Lake, and Glen Ewen, Saskatchewan; and Antler and Souris rivers, Turtle Mountain, Pelican Lake and Treesbank, Manitoba. Measurements of 28 specimens from the above localities average 522.3—224.6—74.6; extremes, 460—215—70 and 595—270—76. Weight, 1.8 (1¼—2¾) lbs. An immature taken at Lodge Creek, Alberta, on August 1, 1927, measured 210—175—45.

Zapus hudsonius hudsonius (Zimmerman). Hudson Bay Jumping Mouse.—Inhabits the Canadian Zone of eastern Manitoba. Measurements of 8 specimens from Whiteshell and Sandilands Forest Reserves average 213.9—131.1—30.6; extremes, 205—121—30 and 218—138—31. Average weight of four examples, 18.4 (16.9—21.3) grams. Intergradation with *Z. h. campestris* apparently occurs in the belt of open, or semiwooded, territory between the coniferous forests of the east and the Red River.

Zapus hudsonius campestris Preble. Prairie Jumping Mouse.—This campestrian form is distributed on the first and second prairie steppes from about the Red River Valley of Manitoba west to southeastern Saskatchewan and points to the north and northwest. It is

locally common. In the territory under review, specimens have been taken near the south end of Lake Winnipeg, at Mowbray, Rock and Pelican lakes, Spruce Woods Forest Reserve, Oak Lake, and the junction of Antler and Souris rivers. Measurements of 13 specimens average 223.1—133.9—29.7; extremes, 211—123—28 and 233—140—31.5. Average weight of 6 examples, 19.1 (17.4—20.2) grams.

Zapus princeps minor Preble. Saskatchewan Jumping Mouse.—Along the International Boundary I have collected this species only on the third prairie steppe of southwestern Saskatchewan and southeastern Alberta where it is apparently uncommon. That it occurs on the second prairie steppe to the east, however rarely, is evident from the fact that Criddle (1929, p. 159) records it at Aweme, Manitoba. Seton (1909) does not list it for Manitoba, nor does Bailey (1926) do so for North Dakota. Measurements of 9 specimens from Big Muddy Coulee, Rocky Creek, Cypress Lake and Battle Creek, Saskatchewan, and Lodge Creek, Alberta, average 219.6—130.7—30.1; extremes, 205—124—28 and 233—140—31.5. Two examples taken at Cypress Lake on June 24-25, 1942, weighed 21.1 and 23.1 grams, respectively.

Napeozapus insignis frutectanus Jackson. Jackson Jumping Mouse.—Two specimens of this rare mammal have been taken by the writer in the Canadian Zone of eastern Manitoba—the first and only records for the province. The first was collected near Caddy Lake, Whiteshell Forest Reserve, on May 24, 1935 (♂, 241—151—31.5); the second, near Cedar Lake on May 8, 1937 (♂, 243—146—32). For further details see Soper (1937 and 1938).

Erethizon dorsatum dorsatum (Linnaeus). Canada Porcupine.—Occurs in southeastern Manitoba west to Red River Valley and on the second prairie steppe northwest to Spruce Woods Forest Reserve and points beyond. Except in the coniferous belt of the east, where it is locally well represented, the species appears to be very rare. On May 12, 1937, an immature female was collected in Sandilands Forest Reserve which measured 625—190—93.

Erethizon dorsatum epixanthum Brandt. California Porcupine.—Found on the prairies and plains of the boundary territory from southwestern Manitoba to southern Alberta. It is comparatively rare on the second prairie steppe west to the Missouri Coteau, but not uncommon in some localities on the high plains west of there to the Rocky Mountains. Many inhabit brushy and timbered areas along Milk River. Four adults collected at Lodge Creek, Alberta, and Rocky Creek, Saskatchewan, have the following measurements and weights: ♀, 790—220—120, wt. 25 lbs.; ♀, 765—205—100, wt. 23 lbs.; ♂, 680—200—105, wt. 17 lbs.; and ♀, 690—230—95, wt. 16 lbs. A juvenile female taken at Lodge Creek on August 2, 1927, measured 530—140—80, and weighed 8 lbs. For additional data see Anderson and Rand (1943b.).

Lepus americanus americanus Erxleben. American Varying Hare.—Occurs in southern Manitoba chiefly north of the range of *L. a. phaeonotus* and westward locally to Cypress Hills. It was nowhere detected in the brushy and timbered portions of Milk River Valley in southern Alberta. This is the form occurring on Turtle Mountain, Manitoba, and Moose and Wood mountains, Saskatchewan. Measurements of 8 specimens from Turtle Mountain, Manitoba, and Val Marie and Battle Creek, Saskatchewan (near southern flank of Cypress Hills) average 409.9—35.2—118.8; extremes, 340—21—100 and 480—27—130. Weight, 2.6 (1½—3½) lbs.

Lepus americanus phaeonotus Allen. Minnesota Varying Hare.—With the exception of Turtle Mountain, this subspecies is distributed in varying numbers over the whole of extreme southern Manitoba from the southeast corner, northwest to about the southern ends of lakes Winnipeg and Manitoba, and southwest to the Antler and Souris rivers west of Turtle Mountain. It also occurs in adjacent southeastern Saskatchewan. I have collected specimens at Marchand, Rock Lake, and the junction of Antler and Souris rivers, Manitoba, and Glen Ewen, Saskatchewan. Measurements of 7 specimens from these localities average 429.3—32.2—117.8; extremes, 370—25—105 and 463—48—125. Average weight of 5 specimens, 2.9 (2—4) lbs. A female collected at the junction of Antler and Souris rivers, Manitoba, on May 18, 1942, weighing 3¾ lbs., contained 7 embryos with an average length of 22 mm.

Lepus townsendii campanius Hollister. White-tailed Jack Rabbit.—With the exception

of extreme eastern Manitoba, which lies within the Canadian Zone, this species is distributed over nearly the whole of the territory under review west to the Rocky Mountains. It is extremely scarce east of Red River, having been personally observed in that quarter only a few times as far east as Pine Ridge, St. Anne and St. Pierre Jolys. To the west it is nowhere particularly numerous over the remainder of the first prairie steppe and the eastern portion of the second steppe, but gradually becomes more common in and beyond southwestern Manitoba. The center of abundance is reached on the plains of the Missouri watershed. Measurements of 7 specimens from Delta Lake, Manitoba; Big Muddy Lake and Val Marie, Saskatchewan; and Lodge Creek, Alberta, average 582—73.3—141.7; extremes, 495—55—135 and 620—70—150. Weight, 6¾ (5½—8) lbs.

Sylvilagus floridanus similis Nelson. Nebraska Cottontail.—This is a comparatively recent newcomer to Manitoba, having apparently entered the province about 1912. Seton (1909) does not mention it in his work on the mammals of Manitoba. Criddle (1929, p. 159) first heard of the animal in the Aweme district when one was caught three miles north of Treesbank on February 11, 1914. It now occurs in the Red River Valley north to Winnipeg and locally westward to the Souris River in the southwestern corner of the province. Reports have repeatedly reached me that cottontails are now quite common along the eastern flank of Pembina Hills and in brushy draws in the Morden and Carman localities. J. W. Vickers informed me in September, 1943, that an occasional individual is seen at Max Lake, Turtle Mountain. A male that I collected near Winnipeg on November 24, 1943, measured 425—46—98 and weighed 2¼ lbs. Also see Anderson (1940).

Sylvilagus nuttallii grangeri (Allen). Black Hills Cottontail.—So far as known at present, this species occurs in Canada only on the third prairie steppe from about Big Muddy Lake, Saskatchewan, west to southern Alberta. In some situations it is common, but many localities were carefully investigated where it was either very scarce or apparently absent. The animals appear to favor brushy coulees and tributary ravines in association with rugged slopes and badlands. Specimens were collected at Nemiskam National Park, and Milk River, north of Sweet Grass Hills, Alberta; and Eastend, Val Marie, Frenchman River at the International Boundary, Rocky Creek, and Big Muddy Lake, Saskatchewan. Measurements of 11 adult and subadult examples from these points average 378.4—40.1—92.9; extremes, 310—32—81 and 429—69—100; five of these averaged 2.6 (1½—3½) lbs. in weight. The following juveniles were also collected: Milk River, July 19, 1927, 225—25—52; Eastend, August 21, 1927, 235—28—55; and Nemiskam National Park, June 25, 1941, 235—36—57 and 238—37—58, respectively; each of the last two had a weight of 9 ounces. Additional points of ascertained occurrence are: Battle Creek (south of Supreme) and Middle Creek (at Govenlock and immediately south of Cypress Hills), Saskatchewan; and at Lodge and North Fork creeks, and St. Mary River (east of Cardston), Alberta.

Cervus canadensis manitobensis Millais. Manitoba Wapiti.—In the early days this species ranged widely over the southern parts of the Prairie Provinces from at least Red River, Manitoba, to Cypress Hills, Alberta. In Manitoba it was more or less abundant in the Pembina Hills, west to Turtle Mountain and northward to the Carberry-Brandon district, and Riding and Duck mountains. It is still numerous on Riding Mountain, but has long since been exterminated in the region to the southward, except for occasional strays from the north. Stuart Criddle has informed me that two were seen in Spruce Woods Forest Reserve in 1940.

A few still inhabit Moose Mountain, Saskatchewan. In 1927, I saw remnants of old wapiti antlers at Rocky Creek, south of Wood Mountain, and was told that these animals formerly roamed in some numbers throughout that area. During the same summer, Spencer Pierce, of Ravenscrag, stated that the species was once fairly common in Cypress Hills, but the last individual he had heard of in this region was shot along Little Frenchman Creek about 18 years before.

Odocoileus virginianus borealis Miller. Northern White-tailed Deer.—It is assumed to be this form that occurs in the Canadian Zone forest of southeastern Manitoba. The animals are at least locally common in this territory east to Sandilands Forest Reserve and

north to Whiteshell Forest Reserve. Numerous examples have been personally observed in these areas. Their range westward is probably as far as the edge of the timber at the open plain east of Red River.

Odocoileus virginianus dacotensis Goldman and Kellogg. Dakota White-tailed Deer.—During the summer of 1927, while working eastward from the Rocky Mountains, nothing definite was learned regarding the occurrence of this deer until the western end of Cypress Hills was reached. Here Howard Taylor assured me that both mule and white-tailed deer inhabited that district. None of the latter was personally noted there, but they were found relatively common along the wooded parts of upper Battle Creek, Saskatchewan, northward to the vicinity of old Fort Walsh. In some areas they were sufficiently numerous to cause marked damage to alfalfa crops. At Eastend, Laurence Potter stated that the "white-tail" was not uncommon along parts of the upper reaches of Frenchman River and tributary creeks originating in Cypress Hills. In many parts of the territory to the east, including Wood Mountain, the animals are common to abundant; the Oak Lake district; Turtle Mountain; the wilder portions of the Pembina and Tiger hills; Spruce Woods Forest Reserve and some of the adjoining country; and points to the east within a few miles of Winnipeg. According to Seton (1909, p. 74) the "white-tail" first spread to Manitoba about 1880. Since then it has steadily increased in numbers despite a late fall shooting season which has been in effect for a considerable period of time.

Odocoileus hemionus hemionus (Rafinesque). Mule Deer.—Formerly occupied the entire region under review from the Rocky Mountains to about the Red River Valley of Manitoba. During the early days of settlement in the West, it was common along Milk River and adjoining areas to and including the whole of Cypress Hills territory, but is now greatly reduced in numbers. Additional southern localities in which the species has been personally observed are Cypress Lake, points along Frenchman River from northwest of Val Marie to the International Boundary, Rocky Creek, Wood Mountain, Big Muddy Coulee and Lake, and Moose Mountain, Saskatchewan, and Rock Lake, Manitoba. A few are reported as still occupying Turtle Mountain, and Criddle (1929, p. 159) states that whereas the animals up to about 1914 frequented the whole of the sand dune country, which is now largely embraced by Spruce Woods Forest Reserve, by 1929 they had become very rare. A similar development has taken place over wide areas of southern Manitoba; apparently this has been caused chiefly by greatly increased settlement of the country and the inability of the mule deer to adjust itself successfully to these conditions. On the other hand, the "white-tail" has usurped its range in steadily augmented abundance.

Alces americana americana (Clinton). American Moose.—In primitive times the moose was widely distributed in the southern extremity of Manitoba, but it is now confined to the coniferous forest along the Ontario border, and Spruce Woods Forest Reserve. Only a remnant of the former population remains in the latter area, but it is common to abundant in various parts of the eastern wilderness. This is particularly true of favorable "pockets" east and northeast of Whitemouth Lake and in Whiteshell Forest Reserve. In the early days the species is said to have inhabited Pembina and Tiger hills and Turtle Mountain; in these parts it was perhaps extirpated as long ago as 1890, or 1900, except for rare stragglers from points farther north. A few still occur on Moose Mountain, Saskatchewan.

Rangifer caribou sylvestris (Richardson). Richardson Woodland Caribou.—Moderate numbers still roam the Canadian Zone fastnesses of southeastern Manitoba. They are commoner in winter than in summer, indicating a north-south movement to and from more heavily populated tracts farther north. In early winter, small bands have frequently been reported in the northern part of Whiteshell Forest Reserve and areas east of Lac du Bonnet. According to information available at present, the species is seldom detected southward from the Whiteshell district, but a few wanderers are doubtless of more or less regular occurrence. During the winter of 1936–37, a number are known to have frequented the east-central part of Sandilands Forest Reserve.

Antilocapra americana americana (Ord). Prong-horned Antelope.—In the early days these animals ranged from about Pembina Hills, Manitoba, west to the foothills of the

Rockies. In the more eastern areas they were scarce as compared with their abundance on the Great Plains from southwestern Manitoba to southern Alberta. The species has long since completely disappeared from the first and second prairie steppes and is now found along the International Boundary only in southwestern Saskatchewan and southern Alberta. In the latter region a few occur on the Milk River plains, but the center of abundance lies chiefly in a strip of country extending from Nemiskam National Park via Pakowki Lake and Manyberries to North Fork and Lodge creeks.

In the adjoining parts of Saskatchewan the animals are common in the Middle Creek territory south to Govenlock and Lodge Creek, and along Battle Creek south of Supreme. Small numbers still exist in the unspoiled lands along Frenchman River from points northwest of Val Marie to the International Boundary and east to the badlands along Rocky and Morgan creeks southwest of Lonesome Butte. I have no recent records of the species' occurrence east of that locality. Two males collected at Lodge Creek, Alberta, on Auugst 3rd, 1927, measured 1480—405—110, and 1380—425—80, respectively.

Bison bison bison (Linnaeus). Plains Bison.—Immense herds of these animals formerly occupied the whole of the Great Plains region under review from Red River Valley of Manitoba to the Rocky Mountains. About 1820 the last of the herds were seen on the Red River plains and they had practically disappeared from southwestern Manitoba by 1867. By approximately 1883 the species in a wild state had become totally exterminated on the plains to the west. The only surviving examples of this form today are to be found in captivity in national and city parks and zoological gardens.

LITERATURE CITED

ANDERSON, R. M. 1929. Division of biology; field work. Ann. Rep. Nat. Mus. Can. for 1927, pp. 16–23.

——— 1940. The spread of cottontail rabbits in Canada. Can. Field-Nat., vol. 54, no. 5, pp. 70–72.

——— 1943. A prior name revived for the bean mouse. Can. Field-Nat., vol. 57, nos. 4 and 5, p. 92.

ANDERSON, R. M. AND A. L. RAND. 1943a. A new lemming mouse (*Synaptomys*) from Manitoba, with notes on some other forms. Can. Field-Nat., vol. 57, no. 6, pp. 101–103.

——— 1943b. Variation in the porcupine (Genus *Erethizon*) in Canada. Can. Jour. Research, vol. 21, Sept. 1943, pp. 292–309.

——— 1943c. Notes on chipmunks of the genus *Eutamias* in Canada. Can. Field-Nat., vol. 57, nos. 7 and 8, pp. 133–135.

——— 1944. The long-tailed meadow mouse (*Microtus longicaudus*) in Canada. Can. Field-Nat., vol. 58, no. 1, pp. 19–21.

——— 1945. A new form of dusky shrew from the prairie provinces of Canada. Can. Field-Nat., vol. 59, no. 2, pp. 47–48.

ANTHONY, H. E. 1928. Field book of North American mammals. New York.

BAILEY, VERNON. 1926. A biological survey of North Dakota. U. S. Dept. of Agr., North Am. Fauna no. 49, pp. 1–226, 8 figs., 21 pls.

BANFIELD, FRANK A. 1941. Notes on Saskatchewan mammals. Can. Field-Nat., vol. 55, no. 8, pp. 117–123.

CRIDDLE, STUART. 1929. An annotated list of the mammals of Aweme, Manitoba. Can. Field-Nat., vol. 43, no. 7, pp. 155–159.

——— 1932. A few records of mammals from Manitoba. Can. Field-Nat., vol. 48, no. 8, p. 188.

GOLDMAN, E. A. 1939. Remarks on pocket gophers with special reference to *Thomomys talpoides*. Jour. Mamm., vol. 20, no. 2, pp. 231–244.

——— 1943. Two new races of puma. Jour. Mamm., vol. 24, no. 2, pp. 228–231.

GREEN, MORRIS M. 1930. Notes on some small Canadian rodents. Can. Field-Nat., vol. 44, no. 3, pp. 69.

HOWELL, A. H. 1929. Revision of American chipmunks (Genera Tamias and Eutamias). N. Amer. Fauna no. 52, pp. 1–157, 9 figs., 10 pls.

HALL, RAYMOND E. 1945. Four new ermines from the Pacific northwest. Jour. Mamm., vol. 26, no. 1, pp. 75–85.

——— 1945a. A revised classification of the American ermines with description of a new subspecies from the western great lakes region. Jour. Mamm., vol. 26, no. 2, pp. 175–182.

JACKSON, H. H. T. 1928. A taxonomic review of the American long-tailed shrews (Genera *Sorex* and *Microsorex*). U. S. Dept. Agric., N. Amer. Fauna no. 51, pp. 1–238, 24 figs., 13 pls.

——— 1931. A note on two species of shrews. Jour. Mamm., vol. 12, no. 2, p. 163.

JACKSON, V. W. 1934. A manual of vertebrates of Manitoba. Univ. of Manitoba, Winnipeg.

MILLER, GERRIT S. 1924. List of North American recent mammals 1923. Bull. 128, U. S. Nat. Mus., Washington.

RAND, A. L. 1943. Canadian forms of the meadow mouse (*Microtus pennsylvanicus*). Can. Field-Nat., vol. 57, nos. 7 and 8, pp. 115–123.

SETON, ERNEST T. 1909. Life-histories of northern animals. An account of the mammals of Manitoba. 2 vols. New York.

——— 1925. Lives of game animals. 4 vols. New York.

SNYDER, L. L. 1938. A faunal investigation of western Rainy River District, Ontario. Trans. Roy. Can. Inst., vol. 22, pt. 1, pp. 157–213.

SOPER, J. DEWEY. 1931. Field notes on the pallid meadow mouse, *Lagurus pallidus* Merriam. Can. Field-Nat., vol. 45, no. 9, pp. 209–214.

——— 1937. *Napaeozapus* in eastern Manitoba. Jour. Mamm., vol. 18, no. 3, p. 369.

——— 1938. Additional note on *Napaeozapus* in eastern Manitoba. Jour. Mamm., vol. 19, no. 1, pp. 108–109.

——— 1938a. Discovery, habitat and distribution of the black-tailed prairie-dog in western Canada. Jour. Mamm., vol. 19, no. 3, pp. 290–300.

——— 1944. Further data on the black-tailed prairie-dog in western Canada. Jour. Mamm., vol. 25, no. 1, pp. 47–48.

——— 1944a. The Mississippi Valley pocket gopher (*Geomys bursarius* Shaw) in Manitoba. Can. Field-Nat., vol. 58, no. 3, pp. 71–72.

——— 1944b. Notes on the large short-tailed shrew at Fort Garry, Manitoba. Can. Field-Nat., vol. 58, no. 3, p. 104.

SURBER, T. 1932. The mammals of Minnesota. Minn. Dept. Conser., Div. Game and Fish. Saint Paul.

National Parks Bureau, Dominion Public Building, Winnipeg, Manitoba.

THE CARNIVORES OF THE SAN ANDRES MOUNTAINS, NEW MEXICO

By Arthur F. Halloran

During the period April 14, 1941, to October 26, 1944, opportunities were presented to the writer as refuge manager of the San Andres National Wildlife Refuge to procure data on the Recent carnivores known to occur in the San Andres Mountains of south-central New Mexico. This federal refuge was created in 1941 to protect the Mexican bighorns indigenous to the range (Halloran, 1944). Part of the management work involved a study of the larger carnivores, which included the trapping of predatory mammals on parts of the area. Although Benson (1933) and others have reported in detail regarding the mammals of the adjacent White Sands area, their emphasis was on rodents. The presence of the Jornada Experimental Range, established in 1913 in the southern part of the mountains, has lightened the utilization of the forage by domestic stock, with the result that, in part of the range at least, a high percentage of the original flora and fauna remains. This is in sharp contrast to many other semi-desert ranges of New Mexico where close utilization of the available forage by domestic stock has, in many cases, radically changed the composition of the fauna and flora.

LOCATION

The San Andres Mountains, approximately 75 miles long, are one of the several north and south lying semi-desert ranges in south-central New Mexico. This narrow range, in parts less than 6 miles wide, extends from San Augustine Pass northeast of the town of Las Cruces in Dona Ana County to Mockingbird Gap in Socorro County. The range lying to the south of the San Andres is known as the Organ Mountains and that to the north, the Oscuro Range. The San Andres Mountains separate the Tularosa Basin, which contains the White Sands area, from the plain of the Jornada del Muerto, which is bounded on the west by the Rio Grande. The San Andres Refuge includes over 21 miles of the southern part of the San Andres Range.

DESCRIPTION OF THE AREA

Meinzer and Hare (1915), Darton (1928), Little and Campbell (1943), and others have well described this range. The following geological description is briefed from their work. The range presents to the west a long slope of upper Paleozoic (Pennsylvanian) limestone with some sandstone and shale that were uplifted at the close of the Tertiary. On the east, the range rises precipitously from the Tularosa Basin, exhibiting a slope of granite and schist surmounted by cliffs of limestone and being, structurally, a westward dipping monocline. The plain of the Jornada del Muerto to the west of the range is an erosion surface formed by lateral planation and has no permanent water except man-created wells and tanks.

Available records indicate that the rainfall in the mountains averages approxi-

mately 12 inches annually while that on the surrounding plains averages approximately 9 inches. The comparatively gentle western slope is dominated in large part by mountain mahogany (*Cercocarpus breviflorus*). In favored locations, particularly on north-facing slopes, are found piñon (*Pinus edulis*) and juniper (*Juniperus monosperma and J. pachyphloea*). The steep eastern slope, rising 3000 to 5000 feet above the plains, harbors a diversity of semi-desert vegetation varying in composition with exposure, altitude, soil, and degree of use by domestic stock. Dominant genera include *Pinus*, *Juniperus*, *Cercocarpus*, *Quercus*, *Yucca*, *Agave*, *Nolina*, *Dasylirion*, *Fouquieria*, *Garrya*, *Bouteloua*, and, on the lower slopes, *Larrea*.

Bailey (1913), in his frontispiece map, clearly shows the zonation of the San Andres Mountains. Flanked on both sides by Lower Sonoran mesas, the range is for the most part in the Upper Sonoran Zone with a patch of Transition Zone present on Salinas Peak, which rises "according to the Wheeler Survey" (Darton, 1928, p. 183) to a height of 9,040 feet.

LIST OF LOCALITIES

Localities mentioned in the text are listed to avoid duplication and to leave a clearer record.

Salinas Peak.—Highest point in the range and located in the northern San Andres Mountains.

Hembrillo Canyon.—Lies north of Deadman and Lostman canyons, which adjoin the refuge on the north.

San Andres National Wildlife Refuge.—Lies astride the range in the southern part. Its northern terminus (T 17S N.M.P.M.) is 21½ miles from its southern terminus (T 20S, N.M.P.M.), which lies approximately 8 miles from the southern end of the range at San Augustine Pass. The refuge is an overlay of the Jornada Experimental Range of the U. S. Forest Service on the west and of District Four of the Grazing Service on the east.

San Andres Canyon.—Also known as Lead Camp Canyon, this arroyo with two permanent waters lies in the northern part of the refuge in T 18S, R 4E.

Baird's Ranch.—Part of this ranch lies along the eastern side of the refuge from just north of San Andres Canyon to well beyond the northeast corner of the refuge.

Ropes Springs.—Permanent spring a few hundred yards west of the western boundary of the refuge at the foot of the western slope of the San Andres Mountains at an approximate elevation of 5,500 feet in Section 8, T 19S, R 4E.

Ash Springs.—Permanent spring 3 miles south of Ropes Springs in Section 21, T 19S, R 4E. Approaching the San Andres Mountains from the west and climbing into the range, one crosses a line of foothills, and looking east from the top of these, the main mountain mass is seen ahead. A north and south trail, over which game and predators travel, stretches for many miles along the valleys between the foothills and the main mountains. This trail, which we call the main San Andres trail, passes Ash Springs. It may be noted here that the valleys turn eastward to drain through deep arroyos in the range to the Tularosa Basin. These rocky drainages serve as entrances for carnivores from the east.

Little Well.—A double well with a windmill in the western foothills in Section 31, T 19S, R 4E.

St. Nicholas Canyon.—Lies between the western foothills and the main mountain mass in the southern part of the refuge in T 20S, R 4E. As the main "runs" or predatory mammal trails are in this rather accessible canyon, it is the best place in the southern part of the range to study carnivores.

Bear Canyon.—Runs east from a low divide through the range at the southern end of the refuge in the southern tier of sections in T 20S, R 4E and 5E. The arroyo running west from this divide is also known to many as Bear Canyon.

NUMBERS OF CARNIVORES

Even though predator control was achieved on parts of the refuge, it was difficult to ascertain the numbers of carnivores in a given area as the range of the individual mammals involved coincided in no way with the legal boundaries of the refuge. Comparative numbers, however, although of small statistical value, give an incomplete picture. During the period March 15, 1940, to June 16, 1944, three men spent part of their time at different periods trapping in the central part of the San Andres Refuge. This work was done on horseback or afoot and was supplementary to the extensive trapping for coyotes and bobcats on the adjoining cattle ranges both east and west of the mountains. The catch of the three mountain trappers was in the ratio of 0.77 coyotes to 1.0 bobcat. In contrast, on the nearby plains, many more coyotes than bobcats were taken. During the same period in the mountains one mountain lion to 5.54 bobcats was trapped. Although we were specializing on the trapping of lions to protect the bighorns from a concentration on a small range, this ratio is of interest when it is realized that every lion trap was capable of (and did) catch not only bobcats but also coyotes. In addition we found that the main lion run in St. Nicholas Canyon was used by practically every large mammal in the area, including deer, rabbits, small carnivores, and coyotes.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to Cecil A. Kennedy of the refuge force who trapped many of the specimens mentioned and who spent long days in the saddle with the writer. C. A. Beasley, a temporary employee of the Fish and Wildlife Service, and other local trappers and ranchers contributed valuable data. Unless otherwise mentioned, all records are supported by at least one specimen. The larger carnivores were identified by Dr. H. H. T. Jackson and Major E. A. Goldman, U. S. Fish and Wildlife Service. The small mammals were identified by either Dr. Jackson or Dr. William B. Davis, assistant leader of the Texas Cooperative Wildlife Research Unit at College Station, Texas. The specimens are deposited in either the Biological Surveys Collection or the Texas Cooperative Wildlife Collection. John C. Gatlin and Louis H. Laney of the Fish and Wildlife Service in Albuquerque have contributed valuable notes on certain species that would not otherwise have been obtained.

ACCOUNTS OF SPECIES

Euarctos americana.—We have not been able to locate any specimens of bears. Local ranchers report that a few bears were present in the middle 90's and that they occasioned some livestock loss. A "black bear" was reported killed in the Ropes Spring area in 1895 according to A. D. Litton now of Hatch, New Mexico. Watson Rich, pioneer rancher of Hembrillo Canyon, told the writer that both "cinnamon" and "silvertip" bears were present in the late 80's and that they appeared in greater numbers in the fall. James Young, a hunter of the Fish and Wildlife Service, told us of a bear track he had seen in 1941 in the Caballo Mountains, just west of the San Andres Range.

Bailey (1931, p. 352) states, "In 1902 in the San Andres Mountains Gaut was told by a ranchman near Salinas that two bear had been killed two years previously near his place." Ligon (1927, p. 96) does not indicate that the San Andres contained bears nor does he indicate that they were present in 1917.

Under date of April 26, 1945, Louis H. Laney, District Agent, Fish and Wildlife Service, wrote from Albuquerque, New Mexico that his records did not indicate that any bears had been taken in the San Andres Range. No signs of bears were noted by the writer during the study. It seems that few, if any, bears can now be found as residents of this range, although individual stragglers might be noted.

Bassariscus astutus flavus.—A male was procured February 23, 1942, at the edge of a steep rocky slope in Ash Canyon. Another male, trapped March 7, 1944, in Ash Canyon below Ash Canyon Springs, weighed 1 pound 11 ounces. Standard measurements of this specimen in inches were: $27\frac{1}{8}$—$13\frac{1}{4}$—$2\frac{7}{16}$—$1\frac{1}{4}$.

These animals frequent the steep cliffs and rough arroyos that drain to the east. Traps set in old cabins for rodents quite commonly catch ring-tails. C. A. Beasley, who has trapped these animals for years in the adjacent Organ Mountains, asserts that favorite winter foods are the seeds of silk tassel (*Garrya wrightii*), juniper berries (*J. pachyphloea*), seeds of hackberry (*Celtis*) and mistletoe berries. We found that these animals were attracted during the winter months to traps baited with fresh meat. Although their tracks and signs were common in suitable localities, no sight records of free individuals were recorded.

Spilogale leucoparia.—Benson (1933, p. 20) recorded this species at Malpais Spring in the Tularosa Basin east of the San Andres Range. Although we have seen and trapped the spotted skunk, we have not as yet saved a specimen for specific identification.

Our trapping records indicate that this species is the least common of the three skunks in the area. We found it in the short brushy arroyos that drain the range to the west onto the plain of the Jornada del Muerto. On January 12, 1942, a *Spilogale* was trapped as it was entering a chicken house at Ropes Springs. While camping at Little Well in an old CCC barracks building on September 15, 1942, we were awakened in the early morning hours by a skunk. The animal rather thoroughly foraged throughout the large room and finally entered a stove pipe. Stove pipe and skunk were removed from the room with no ill effects.

Mephitis mesomelas varians.—A male was trapped at Mountain (Mud) Tank in St. Nicholas Canyon in the piñon-juniper type on November 1, 1943. Of the three skunks, this species was most frequently caught. It was common both in the mountains and around the refuge headquarters buildings in the Lower Sonoran Zone, 13 miles west of the range. In February 1945, a striped skunk was trapped in a bobcat set in the arroyo near Little Well in the western foothills.

Conepatus mesoleucus mearnsi.—A male was trapped by Kennedy in Ash Canyon December 29, 1944. These animals were found throughout the middle and lower elevations of the range. As with the other skunks, we have no records from the extreme high points of the range. We found hog-nosed skunks to be most numerous in Bear Canyon near the southern end of the range. In this area there was a series of old goat enclosures where the animals make excavations under the corral posts in search of insect larvae. On December 26, 1941, two skunks, dead but a short time, were found in Bear Canyon. No external marks indicated the cause of their death. There had been a cold snap, however, at this location, which is near the northern limits of the range of the genus (Barber, 1902, p. 192). Local minimum tem-

peratures nearby at refuge headquarters were: December 25, +27° F.; December 24, +27° F.; December 23, +17° F. Late in the afternoon of September 16, 1942, we rode up to a *Conepatus* rooting in the heavily shaded damp earth and rocks just above the horse trough at Ash Springs.

Taxidea taxus berlandieri.—A skull was found in St. Nicholas Canyon at the site of a lion kill (deer). At 5:30 p.m. on October 22, 1942, a badger was seen by Kennedy in a rocky draw about one mile south of water in San Andres Canyon. Badgers, according to our records, are not as numerous as the skunks and during the study only a few were trapped on the main San Andres trail. Several badgers were also reported to the writer from the Jornada Plain. On February 8, 1944, we examined a trapper-taken hide from the *Larrea* type on the east side of the range.

Vulpes macroura.—On January 28, 1942, a western red fox was caught by Kennedy in the Upper Sonoran Zone (Halloran, 1942). We have no proof that this animal was a member of an isolated "colony" as in the case of the red fox of the upper Sacramento Valley (Grinnell, Dixon, Linsdale, 1937, pp. 381–386), but the statements of local people tend to substantiate this theory.

When we secured our specimen we inquired of local ranchers concerning its status. One local man had seen a trapped specimen from Ash Canyon and another ranchman stated that he had known of their existence in the range for many years. On February 16, 1943, Mrs. Frank Ridinger stated that her husband caught a female red fox and a pup in 1931 at the Point of Sands in the Tularosa Basin a few miles to the east of the San Andres Mountains. In April 1944, Walter Baird, a rancher, told of frequently noting a red fox several years ago in Lostman Canyon. Townsend (1893a) mentions the presence of red foxes in the Organ Mountains. It seems possible that there is a very small local population. We have been unable to learn of any introductions of this species.

Vulpes macrotis neomexicanus.—The type locality of the New Mexico desert fox has been established as Baird's Ranch in the San Andres Mountains (Halloran, 1945). This animal is not common locally. A skin was procured from a resident near the White Sands area a few miles from the Baird Ranch and sent to Davis as was a skull and skin secured near Parker Lake on October 4, 1943. Both of these locations are on the eastern side of the mountains near the southern end of the range. Careful inquiry has revealed a dearth of recent records for the western side of the mountains. Bailey (1931, p. 299) noted one "in the open Jornado Valley a couple of miles west of the little town of Engle" which is near the north end of the range. During the last week of January 1944, J. A. Young of the Fish and Wildlife Service caught and released a desert fox one-fourth mile east of South Well on the Jornada Experimental Range in a deteriorated grassland type now dominated by *Yucca elata* and *Gutierrezia* sp. This is, to our knowledge, the first such fox caught west of the San Andres Mountains in several years. At no time did we record this fox in other than the Lower Sonoran plains and washes surrounding the range.

Urocyon cinereoargenteus scotii.—A male gray fox was trapped December 21, 1943. This animal weighed ten pounds (entire weight). Standard measurements in inches were: 40½—17—5¾—3¼. The gray fox is by far the commonest of the three foxes in the San Andres area. Kennedy noted an individual resting under a bush in the piñon-juniper type of St. Nicholas Canyon at 1:10 p.m. September 21, 1942. In late summer, fall, and winter, fox droppings containing prickly pear seeds (*Opuntia* sp.) were found on the trails. On the morning of July 30, 1942, a fox was noted one-half mile north of Ash Springs at the same time and place that a covey of 18 Gambel quail was seen. At 12:40 p.m. on August 26, 1942, a fox was seen in a small arroyo just below the corrals of Ropes Springs.

Canis latrans texensis.—Several specimens have been sent to Biological Surveys. One (A.F.H. #70) was identified as *mearnsi*, but later under date of April 20, 1944, Dr. H. H. T. Jackson sums up the situation as follows: "I do not feel certain that you have more than one subspecies of coyote in the San Andres region, though it may be that in the Lower Sonoran valleys *Canis latrans mearnsi* may occur. In such lower regions in extreme southwestern New Mexico (Hidalgo County) *mearnsi* undoubtedly occurs, but specimens from east of the

Rio Grande that have been referred to that form will have to be restudied before we can accept the idea that two forms are present in that region. I have examined your specimens (no. 89, just received and no. 96 mentioned in your letter of January 15) and both are *Canis latrans texensis* as we know that subspecies now. Possible later monographic studies may change our ideas, but I rather doubt if they will."

Coyotes are commonly found on the plains surrounding the range, as well as throughout the mountains. On May 19, 1944, we noted fresh tracks of a coyote on the rough talus slope above and to the east of Ash Springs. It was evident that the animal had come into water the night before from the high rim country also frequented by lions and bobcats. A female coyote, possibly the same animal, had been trapped that morning by Beasley about one mile north of the springs. Although coytes are not as numerous in the range as on the nearby mesas, they can be considered common. There were few, if any, times when we rode through the mountains that the tracks and signs of coytes were not evident. We have rather frequently caught coytes in "blind" (no bait or scent) sets on trails in the piñon-juniper type, the favored haunts of both mountain lion and bobcat. Coyotes also enter the range through the rough arroyos that drain to the east and the west. During August, coyote droppings indicated that the animals fed on prickly pear fruits (*Opuntia* sp.), among other things. On August 19, 1942, shortly after 6:55 a.m. a group of 23 bighorns was located on a rim just below us on the eastern side of the range. They were bunched and looking down the canyon. The apparent cause of this temporary concern was a coyote howling and yapping directly under the sheep. The bighorns, however, soon discovered us and ran into the cliffs disturbing more sheep and two deer that had been lying down. No further notes on this coyote were obtained. Spencer (1943, p. 9) also records coyotes on the rough Tarryall bighorn range of Colorado, where two yearling sheep were killed by them during 1940.

A male trapped February 21, 1944 in Ash Canyon weighed 26 lbs. (entire weight) with standard measurements in inches of $48\frac{1}{2}$—$14\frac{1}{4}$—$7\frac{3}{8}$—$3\frac{3}{4}$.

Canis lupus.—We have no late records of wolves in the range and no San Andres specimens have been examined. James Young of the Fish and Wildlife Service told us that Walt Gilmore of Engle, New Mexico, remembered his father mentioning that wolves used to kill cattle on the Tourney range (now Jornada Experimental Range) in the early 1900's. An old Forest Service report (Forsling, 1919) mentions the fact that "An occasional "lobo" wolf has been reported near the Jornada Range Reserve. . . . The last lobo wolf in the vicinity was caught in 1917 just south of the Reserve after it had done much damage." Search of Fish and Wildlife Service records and inquiry among local people revealed that a wolf (possibly the one mentioned by Forsling) was taken in August 1917 by Eddie Anderson, a hunter of the Biological Survey on the Organ Mountains ranch of Emmett Isaacks. Our inquiries indicate that this was the last wolf taken in the immediate vicinity of the San Andres Range. It is possible, however, that a few wolves will be found in or near the San Andres, as these animals are known to drift in from Mexico and still are being rather regularly trapped as they cross the border into Hidalgo County in southwestern New Mexico (Young and Goldman, 1944, p. 84).

Felis concolor azteca.—The Mexican cougar is a common resident of the range. In 1940, four were taken. Federal and state hunters have removed many lions from the range since 1935. Under date of March 20, 1923, E. N. Nelson, Grazing Examiner, Jornada Range Reserve, wrote E. L. Pineau, Biological Survey, for help in trapping lions reported in the San Andres Mountains. Townsend (1893b) records a sight record from the Organ Mountains, which we quote: "The only case which I can personally vouch for is the following: While camped at the base of the Organ Mountains, at the northeastern end of the range, in the latter part of November, 1891, I saw a puma one morning about 8 o'clock disappearing over a ridge of rocks. He had emerged from the high and thick growth of *Yucca angustifolia* which covers the San Augustine plains at this point, and had disappeared before I could get a shot at him. One of the members of our party had passed within a few yards of a *yucca*, behind which he was crouching at the time, but without seeing him. He was apparently about three and one-half feet long, not including tail, and was of a yellowish gray color. Subsequent search among

the rocks failed to show any trace of him." Two other paragraphs of this article tell of the trials of the pioneer ranchers of the Organ Range: "The puma is not rare in Soledad Canon, in the Organ Mountains, as the following cases will show. Mr. Jeff Isaacs, who has a ranch in the canon, has killed twelve of these animals within the past four years. They have caused serious depredations among his lambs and colts. He tells me that they have killed five colts for him, and also numbers of calves and sheep. The skin of one which he killed with a pistol, in the fall of 1889, measured nine feet from end of nose to tip of tail (stretched? A.F.H.). This measurement is vouched for by Mr. W. R. Fall, of this place. The canon is a little south of east of Las Cruces, Mr. Isaac's place being about twenty miles from here."

"Mr. Fall also tells me that Mr. G. R. Beasley, who has a ranch a mile or two beyond (east of) Isaac's ranch in Soledad, killed a puma in June, 1892, and says that there are several of these animals now alive in that vicinity." Bailey (1931, p. 288) records that in 1902 Gaut reported two lions seen a few years previously in the Salinas Peak area and also a few in the Bear Canyon area.

Some of the lions apparently drift north into the San Andres Range from the Organ Mountains. On June 25, 1942, we trailed a female mountain lion from a kill at a spring near the southern edge of the refuge north over several miles of trail to St. Nicholas Canyon, where the animal was found in a trap.

During both summer and winter the lions use well-defined trails through the piñon-juniper type on moderate to steep slopes. Their signs are also found high in the steep brush-shaded arroyos that originate in the highest reaches of the range. Many "saddles" on the crest of the range contained their signs and points overlooking water were frequented parts of their beat.

Standard measurements *in inches* and related data of a few lions from the area are as follows:

DATE TRAPPED	SEX	TOTAL LENGTH	TAIL-VERTEBRAE	HIND FOOT	EAR FROM NOTCH
2/ 2/42	♀	75	29	10	3½
2/27/42	♀	76	28	10	4
6/25/42	♀	81	24	10	3½
2/17/43	♂	89	30	11½	4
6/ 5/44	♀	74	26½	9	3½

A few mountain lion droppings were collected and sent to Charles C. Sperry of the Denver Laboratory, Fish and Wildlife Service, for determination of contents. The animal matter contained in these was as follows: Mexican bighorn (1), deer only (3), and deer and porcupine (1). A mountain lion dropping collected by a Fish and Wildlife Service employee in January 1944 in the Kofa Mountains of southwestern Arizona and analyzed by Sperry also contained remains of bighorn. We noted one domestic lamp kill and several deer kills during our time in the field. Bailey (1931, p. 289) and Spencer (1940, p. 9) have also indicated that cougars kill bighorn.

Felis onca arizonensis.—We have been unable to locate any jaguar specimens from the San Andres Range. Bailey (1931, p. 284) received reports of jaguars from this range. In 1937 a Biological Survey hunter named Bannerman asserted that his dogs "jumped" a jaguar. The animal was reported as sighted, but not captured as it would not "tree" as does a lion. Watson E. Rich, told us of a jaguar killed many years ago by Bob Burch, a foreman in the late 1800's on the Goldberg Ranch (Jornada Experimental Range) in the Caballo Mountains between the San Andres Range and the Rio Grande.

During our stay we did not find any trace of jaguar. We should not be surprised, however, if a wandering "tigre" is sometime seen in this area.

Lynx rufus baileyi.—The bobcat is a common resident of the range and can be found at all elevations. Bobcat signs were noted in all locations where we found lion signs.

The largest bobcat trapped on the refuge was a male with an entire weight of 35 pounds. Standard measurements in inches of this specimen were 41—5½—8—4. Two other winter-caught males weighed 31 pounds (fairly fat) and 28 pounds (poor), respectively. On April 21, 1941, a bobcat trapped in Ash Canyon was examined by the writer and found to contain two unborn young, each 4¾ inches long. On February 20, 1942, a female was trapped. She was traveling at the time with a male that was caught the same day in an adjacent trap.

On February 25, 1943, at 12:50 p.m. we noted a bobcat quietly crawling along a narrow trail high in the cliffs or rims of the eastern side of the range north of San Andres Canyon. We came upon this animal, apparently hunting just ahead of us, as we were following a set of fresh sheep tracks through this precipitous area.

LITERATURE CITED

Bailey, Vernon. 1913. Life zones and crop zones of New Mexico. North American Fauna, no. 35.

——— 1931. Mammals of New Mexico. North American Fauna, no. 53.

Barber, C. M. 1902. Notes on little-known New Mexican mammals and species apparently not recorded from the territory. Proc. Biol. Soc. Washington, vol. 15, pp. 191-193.

Benson, Seth B. 1933. Concealing coloration among some desert rodents of the southwestern United States. Univ. California Publ. Zool., vol. 40, no. 1, pp. 1–70.

Darton, N. H. 1928. "Red beds" and associated formations in New Mexico. U. S. Geol. Surv. Bull. 794.

Forsling, Clarence L. Notes on rodents, predatory animals and game on the Jornada Range Reserve. Typed report dated 12–23–1919 in the files at the headquarters of the Jornada Exp. Range, U. S. Forest Service, Las Cruces, New Mexico.

Grinnell, Joseph, Joseph S. Dixon, and Jean M. Linsdale. 1937. Fur-bearing mammals of California. Univ. California Press. 2 vols.

Halloran, Arthur F. 1942. The western red fox in southern New Mexico. Jour. Mamm., vol. 23, no. 2, p. 223.

——— 1944. History and present status of bighorn in south-central New Mexico. Jour. Mamm., vol. 25, no. 4, pp. 364–67.

——— 1945. The type locality of *Vulpes macrotis neomexicanus*. Jour. Mamm., vol. 26, no. 1, pp. 92–93.

Ligon, J. Stokley. 1927. Wild life of New Mexico; its conservation and management. New Mexico State Game Comm., Santa Fe. 212 pp.

Little, E. L. Jr., and R. S. Campbell. 1943. Flora of Jornada Experimental Range, New Mexico. Amer. Midl. Nat., vol. 30, no. 3, pp. 626–670.

Meinzer, O. E. and R. F. Hare. 1915. Geology and water resources of the Tularosa Basin, New Mexico. U. S. Geol. Surv., Water Supply Paper 343.

Spencer, C. C. 1943. Notes of the life history of rocky mountain bighorn sheep in the Tarryall Mountains of Colorado. Jour. Mamm., vol. 24, no. 1, pp. 1–11.

Townsend, C. H. T. 1893a. On the life zones of the Organ Mountains and adjacent region in southern New Mexico with notes on the fauna of the range. Science, vol. 22, pp. 313–315.

——— 1893b. Notes on the occurrence of the puma (*Felis concolor* L.) in southern New Mexico. Zoe, vol. 3, no. 4, p. 309.

Young, Stanley P. and C. A. Goldman. 1944. The wolves of North America. American Wildlife Institute, Washington, D. C.

U. S. Fish and Wildlife Service, Yuma, Arizona.

RECENT AND PLEISTOCENE MAMMALIAN FAUNA OF BRAZOS COUNTY, TEXAS

By Randolph L. Peterson

Brazos County, located in east-central Texas, is typical of the Greater Postoak Belt (fig. 1) of eastern Texas and western Louisiana. This area receives contributions from both eastern and western faunas and appears to be an area of differentiation for a number of mammals including *Scalopus*, *Conepatus*, *Lutra*, *Geomys*, and *Peromyscus* (Davis, 1939).

Acknowledgments are made to Dr. W. B. Davis for many helpful suggestions regarding Recent mammals, to the late C. J. Hesse for assistance and advice regarding the fossil mammals, and to H. S. Coleman who aided in carrying out field work.

DESCRIPTION OF THE COUNTY

Brazos County has an area of approximately 600 square miles. The general elevation ranges from 200 to 400 feet above sea level, the surface sloping gently toward the southeast. The topography is level to gently rolling, with no deep stream dissection or conspicuous topographical relief. Two distinct vegetative types, the uplands and the river and creek bottoms, are present, the former comprising about 75 percent of the area and the bottomlands about 25 percent (fig. 2).

The area is part of a coastal plain, mostly of deposits of Eocene age, which has gently dipping beds forming most of the present land surface (fig. 3). In the southern tip of the county, Oligocene beds lie adjacent to Miocene deposits just outside the boundary. Part of the county is made up of river terraces of Pleistocene and Recent origin. The soils of the county may be placed in three general groups; forest soils, which are fine sandy loams for the most part; prairie soils, which are predominantly clay loams; and recent alluvial soils, most of which are clays.

The uplands were at one time covered with woods and open prairies (fig. 4). The prairies comprise roughly 15 percent of the upland area and vary in size from a few acres to several square miles. The most extensive prairies, much of which is now used for agricultural purposes, are in the northern part. The wooded areas are covered chiefly with postoak, scattered yaupon, and other species of smaller undergrowth.

The river bottoms are subject to overflow and are characterized by heavy clay soils of alluvial origin. Most of the creeks are relatively short and intermittent. At one time the bottom lands were heavily wooded with oak, hickory, elm, and pecan.

The Navasota River bottomlands, one to two miles wide, extend 40 miles along the entire eastern boundary. The bottomlands of the Brazos River on the southern and western boundaries are not continuous. In the southeastern part of the county these bottomlands are about two to four miles wide and ex-

FIG. 1. Map of Texas showing locations of Brazos County (solid black) and the postoak belt

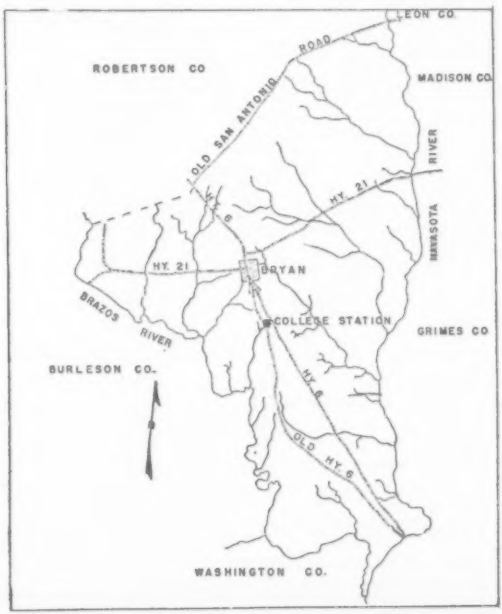

FIG. 2. Map of Brazos County, Texas

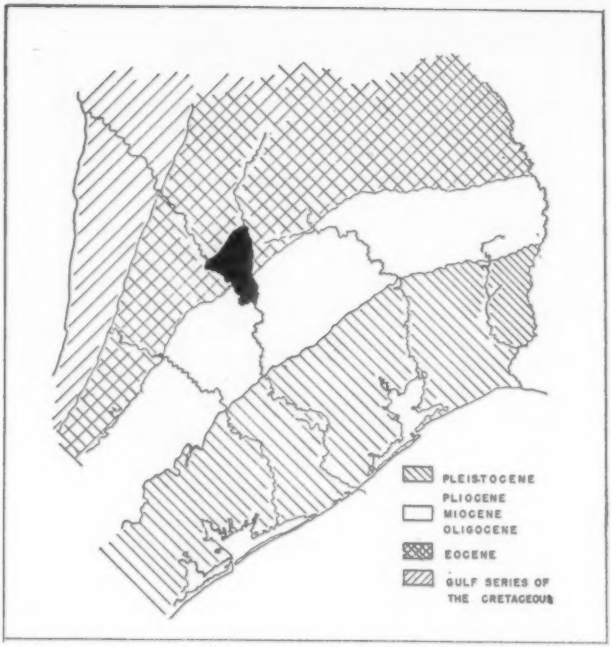

FIG. 3. Map showing geologic position of Brazos County in southeastern Texas

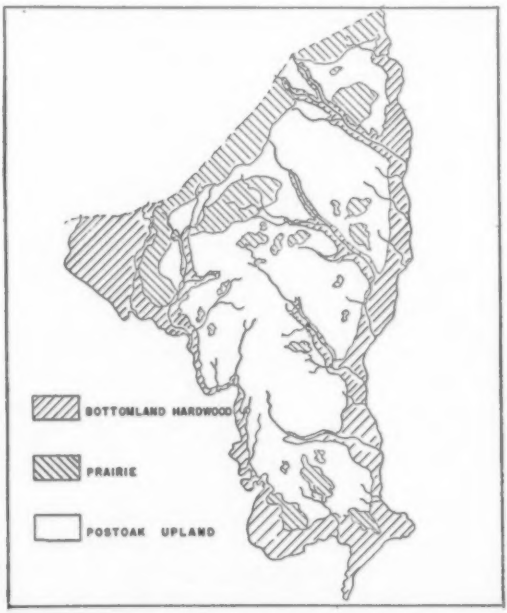

FIG. 4. Map showing vegetative divisions of Brazos County, Texas

tend about 12 miles along the Brazos County side of the river. Above this point for about 20 miles the present river flood plain is on the opposite side of the river. Here the uplands extend to the river bank. In the extreme western part of the county, the flood plains are again found. Here the bottomland is about six miles wide and extends into the county for about six miles.

The Brazos River bottoms are excellent for production of cotton and about 90 percent of the land is cultivated. The soils found in the Navasota River

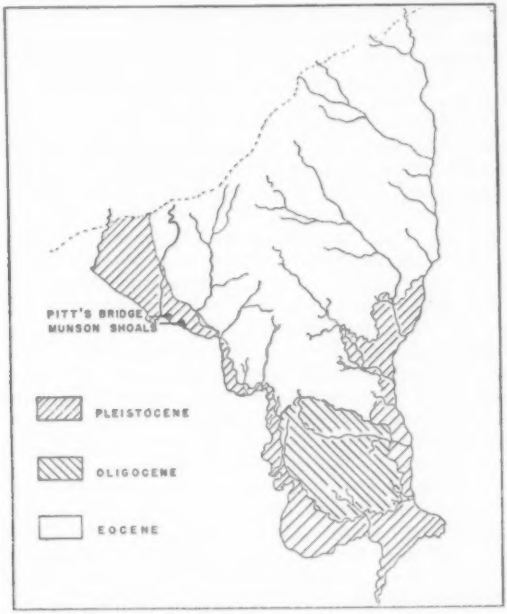

FIG. 5. Geologic map of Brazos County, Texas, showing locations of Pitt's Bridge and Munson Shoals fossil localities

Bottom are much less productive and are flooded semi-annually. Only about 10 percent of this area has been cleared. Much of the upland soils have been used for agriculture. Twenty percent of the total area of the county is cultivated land. Much of the land is heavily overgrazed and seriously eroded. The majority of the farms are managed by tenant farmers.

The average annual precipitation is 38 inches; April and May are the months of heaviest rainfall. Droughts are common in summer. The mean annual temperature is about 68°F., the extremes ranging from about 10° to 110°F.

PAST AND PRESENT MAMMALIAN FAUNAS

The county has at least three deposits of different age (fig. 5). The Eocene, which constitutes a major part of the county, and the Oligocene deposits have yielded no fossil vertebrates. The Pleistocene deposits are all alluvial. Many fragments of fossil vertebrates, chiefly mammals, have been discovered in them. The greater part of this fossil material has

come from one general locality known as Pitt's Bridge and Munson Shoals on the Brazos River 10 miles west of Bryan. The first collecting done in this area was by Dr. Mark Francis in 1899, whose collection was described by O. P. Hay (1924). Continued collecting has been carried on at this locality.

Order Marsupialia.—No fossil records of this order are known from the county, but the Virginia Opossum, *Didelphis virginiana virginiana*, occurs here at present.

Order Insectivora.—This order is known only from Recent forms, which include the Texas mole, *Scalopus aquaticus cryptus* and the little short-tailed shrew, *Cryptotis parva parva*.

Order Chiroptera.—Of the bats, only Recent forms have been recorded. These are the Mexican free-tail bat, *Tadarida mexicana*, the evening bat, *Nycticeius humeralis humeralis*, and the red bat, *Lasiurus borealis borealis*.

Order Carnivora.—In Pleistocene deposits a fragment of a coyote, *Canis* sp., and a large cat, *Felis*, sp., have been found.

The blackbear, probably *Euarctos americanus luteolus*, is known to have occurred in the county prior to 1860. The raccoon, *Procyon lotor fuscipes*, occurs throughout most of the area. The ringtail cat, *Bassariscus astutus flavus*, occurs throughout the county, although the range of this animal is now restricted largely to the western half of the state. The mink, *Mustela vison mink*, is of common occurrence. The otter, *Lutra canadensis texensis*, occurred in the county until about 1932. Otter now are rare throughout eastern Texas and probably none occurs in Brazos County at present. Two skunks, *Spilogale indianola* and *Mephitis mephitis mesomelas*, are residents of the area. According to several reports the gray fox, *Urocyon cinereoargenteus floridanus*, were scarce in Brazos County by 1910. Under protection of a closed trapping season they are now numerous. The red wolf, *Canis niger rufus*, occurs in all counties surrounding Brazos County, but no records within the county are known since about 1935. Wolves have been rare in this area for several years. The bobcat, *Lynx rufus texensis*, is still found in most of the county. Early settlers report "many wolves, bears, panthers, and wildcats in the county" (Marshall, 1935).

Order Rodentia.—Early historic accounts do not mention rodents and as yet no fossil specimens have been discovered. The western limits of the gray squirrel, *Sciurus carolinensis carolinensis*, was found by Goodrum (1937) to be along the eastern boundary of Brazos County. All indications show a steady decline in the number of these squirrels in this area. Other rodents found in the county today include the following: fox squirrel, *Sciurus niger ludovicianus*; flying squirrel, *Glaucomys volans texensis*; pocket gopher, *Geomys breviceps brazensis*; hispid pocket mouse, *Perognathus hispidus hispidus*; golden harvest mouse, *Reithrodontomys fulvescens aurantius*; white-footed mouse, *Peromyscus leucopus brevicauda*; cotton rat, *Sigmodon hispidus texianus*; wood rat, *Neotoma floridana attiwateri*; roof rat, *Rattus rattus alexandrinus*; and the housemouse, *Mus musculus*. Brazos County is within the former range of the beaver, *Castor canandensis texensis*. No records for the county are available until 1939, however. At this time a few were released there by A. H. Cook under the direction of the Texas Cooperative Wildlife Research Unit. As yet it is difficult to state definitely the status of this animal in the county.

Order Lagomorpha.—This order is represented in the county by three Recent forms. No fossils have yet been discovered. The jackrabbit, *Lepus californicus melanotis*, the cottontail, *Sylvilagus floridanus alacer*, and the swamp rabbit, *Sylvilagus aquaticus aquaticus*, are common in the area.

Order Artiodactyla.—A distinct and interesting change has come about within this group of mammals during and since the Pleistocene age. Records show that a large and varied fauna of both browse- and grass-feeders were present in the area in the Pleistocene. There has been a distinct decline in the number of species even through historic time. The earlier inhabitants of the area, as indicated by fossil records, included deer, bison, camel, antelope, musk ox, and possibly others. Among these fossils were a deer, *Odocoilcus* sp; a large camel, *Camelops* sp; a four-horned antelope, *Tetrameryx shuleri*; a large bison, *Bison latifrons*; a plains bison, *Bison* sp and a musk ox, *Bootherium bombifrons*.

Most of these forms became extinct before white man explored Texas. In 1822, W. B. Dewees one of the first settlers, found many buffalo throughout the northern part of the county. A letter written by him on July 16, 1822, states: "You would scarcely believe me were I to tell you of the vast herds of buffalo which abound here; I have frequently seen a thousand in a day between this place (meaning the mouth of the Little Brazos River) and the mouth of the Little River." This is a distance of about 20 miles. It seems evident that the bison became extinct in this area very soon after white man occupied the land.

The white-tailed deer, *Odocoileus virginianus*, is the only species of this order that has not been completely extirpated from the county. As late as 1934 few native deer were present in the Navasota River bottom in the northern part of the county. Since then several liberations of deer from the Edwards Plateau of Texas have been made.

According to an early letter written by Dewees, peccaries, *Pecari angulatus angulatus*, were common in the Brazos County region. An excerpt of this letter reads: "Bears are very plenty but we are obliged to use great care when hunting for them lest the *havelenas* (meaning the peccary) kill our dogs."

In 1822, large herds of wild cattle were reported by Dewees: "We have only to go out for a few miles into the swamp between the Big and Little Brazos to find as many wild cattle as one could wish." These cattle were probably descendants of stock brought into this region by early Spanish explorers.

Order Perissodactyla.—Three members of this group have been recorded all of which have become extinct. Two species of Pleistocene horse have been discovered, *Equus complicatus* and *Equus francisi*. A tapir, *Tapirus haysii*, was also found in these deposits. The early Spaniards also left horses, which were seen by the early settlers. Few were ever captured, but they were often killed because of their habit of luring away the domestic horses of the settlers, according to J. W. Covey, an early settler (Marshall, 1935).

Order Proboscidia.—As indicated by the number of fossil specimens taken, this must have been one of the most common animals in the Pleistocene. No less than 150 individual elephants have been discovered within a hundred-mile radius of College Station. Hay (1924) lists three mastodons: *Cuvieronius gratus*, *Mammut americanum*, and *Mammut progenium*. The elephants were *Mammuthus imperator* and *Mammuthus columbi*.

Order Xenarthra.—In this order are some of the most interesting changes of the mammalian fauna in the area. In the Pleistocene, five different members of this group are known to have occurred here. Three of them were large ground sloths, *Megatherium mirabile*, *Megalonyx* sp, and *Mylodon* sp. A huge *Glyptodon* also occurred here, as well as the giant armadillo *Chalmytherium septentrionale*. Sometime in the Pleistocene, all these animals became extinct and for a long time no member of the order occurred in this part of Texas. It was not until about 1910, according to Taber (1939), that the armadillo, *Dasypus novemcinctus texanus*, entered the county on its northward extension of range. Since that time the number of armadillos has steadily increased.

DISCUSSION

When comparing the past and present mammalian faunas of a particular area, it must be remembered that it is practically impossible to get a complete picture of the fossil fauna. Unless the conditions were such as to preserve at least the hard parts of these early mammals from immediate decay, there was small probability of fossilization. With the multitudes of chances against preservation, it is evident that the known records represent a small percentage of the life that doubtless existed in the Pleistocene. More than 600 species are reported from the Pleistocene of the United States.

Because of the alluvial nature of the Brazos County deposits, the bulk of fossil material consists of fragments of the larger species. Such orders of mammals as Marsupialia, Insectivora, Chiroptera, Rodentia and Lagomorpha are entirely

absent from the list of fossil mammals. There is also a noted absence of small carnivores. Among the larger fossil mammals, the greater number were browse feeders, which suggests that the areas adjacent to the streams were covered with heavy vegetation. The presence of many such grass feeders as horses, antelopes, and bison indicates that there must have been some rather extensive prairie land within "watering" distance of these streams. Just how late these Pleistocene mammals lived, and in what order they became extinct is difficult to say. The almost total absence of large carnivores suggests that predation played only a minor part in their extermination.

As is the case in most instances, man has played a major rôle in the changes in the mammalian fauna since historic time. Such species as bear, wolf, and panther were regarded as being detrimental to man's interest and consequently they were extirpated as rapidly as possible. The great value of otter pelts soon caused removal of this animal from the area by trappers. Man's conquest of the land affected the mammalian population in several ways. Domestic horses and cattle were released as wild stock by the early explorers. These populations were later exterminated at a rapid rate. As soon as man took over the land, he immediately began to exert his influence by addition of agriculture. The time of this activity is directly related to the extermination of such forms as buffalo and peccary.

SUMMARY

1. As indicated by a study of both the past and present mammalian faunas of Brazos County, Texas, interesting changes have taken place within a rather limited locality since the beginning of the Pleistocene Age.

2. The Pleistocene mammalian fauna of the county, as indicated by known fossil specimens from the area, represents only a few of the forms that doubtless lived here during the past. The orders Marsupalia, Insectivora, Chiroptera, Rodentia and Lagomorpha have not been found in this area as fossils.

3. The present mammalian fauna is thought to differ from that of the Pleistocene mainly in the loss of forms once present.

4. The known Pleistocene and Recent mammalian fauna includes 10 orders, 29 families, and at least 56 kinds of wild mammals.

5. Of this fauna 21 kinds are known only from fossils, representing 13 families and 5 orders.

6. Since man has occupied Brazos County six native species have been exterminated. These are the bear, otter, wolf, panther, peccary, and bison.

7. The armadillo has entered the county within historic time; *Mus* and *Rattus* occur as exotics and beaver and deer have been re-introduced.

LITERATURE CITED

Davis, W. B. 1939. A new Peromyscus from Texas. Occ. Papers, Mus. Zool. Louisiana State University, no. 2.

Goodrum, P. 1937. Notes on the gray and fox squirrels of eastern Texas. Trans. 2nd. North American Wildlife Conf., pp. 499-504.

HAY, O. P. 1924. The Pleistocene of the middle region of North America and its vertebrated animals. Carnegie Inst. of Wash., Publ. no. 322 A, pp. 1–371, pls. 1–29, figs. 1–5.

MARSHALL, E. G. 1935. History of Brazos County, Texas. An unpublished thesis manuscript. Univ. of Texas, Austin, Texas.

TABER, F. W. 1939. Extension of the range of the armadillo. Jour. Mamm., vol. 20, no. 5, pp. 489–493.

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THE EFFECT OF REMOVAL OF THE ZYGOMATIC ARCH IN THE RAT

BY S. L. WASHBURN

The purpose of this study is to determine the rôle of the zygomatic arch in the development of the rat's skull. Ever since the studies of Fick (1859) there have been sporadic attempts to use experimental methods to further the understanding of the mammalian skull. Recently, there has been increased interest in such studies. Baker (1941) determined the force exerted by erupting teeth in a number of animals. Pratt (1943) discovered that removal of the masseter muscle produced manifold changes in the skull of young rats. Giblin and Alley (1944) have described the deformations resulting from induced, premature suture closure in dogs.

Considering the importance of such studies, it is surprising that, nearly 90 years after Fick's pioneer work, it is still impossible to find a series of experiments which will allow one to evaluate the rôle of teeth, muscles, sutures, and individual bones in the development of even the commonest laboratory animal. Yet such knowledge would seem to be essential for the taxonomist who must evaluate the differences between mammalian skulls, for the paleontologist who attempts to reconstruct soft tissues from bony remains, and for the anthropologist who tries to interpret small variations in the primate skeleton.

Obviously, many experiments must be performed before the postnatal development of any mammal is completely understood. The studies so far available raise at least as many problems as they settle. This is due in part to the paucity of material and in part to the fact that the few experiments available have been performed on a variety of animals of different ages so that comparisons are difficult.

Further progress requires that many experiments be performed on one type of animal so that results may be compared with as few complications as possible.

Newborn rats are suitable for this type of research. They are relatively undeveloped at birth but grow rapidly. Difficulties of surgical technique and anesthesia are at a minimum (Griffith and Farris, 1942). Rats are prolific, hardy, and cheap. Excellent anatomies are available (Howell, 1926 and Greene, 1935). The writer hopes that others will become interested in the problems

offered by the rat's skull, so that in years to come the factors influencing the form of at least one mammalian skull may be fully understood.

In the paper by Pratt, already referred to, it was shown that removal of one masseter muscle causes marked asymmetrical development in the skull of the rat. The greatest results were found when the zygomatic arch was removed along with the muscle. Pratt speculates whether these distortions were due to the removal of the arch or to the fact that the masseter was more completely obliterated when the arch was destroyed. This raises the question of what rôle the zygomatic arch plays in the normal development of the rat's skull. Does removal of the arch alone cause cranial asymmetries? It was this problem which the writer set out to solve.

METHODS

Removal of the zygomatic arch (zygomatic bone, and part of the zygomatic processes of the temporal and maxillary bones) is easily accomplished in the new-born rat. The rats are placed in the ice tray of an ordinary electric refrigerator until they become motionless and lose their normal pink color (about ten minutes). Wiesner (1934) first described this method of anesthesia which works very well for the first two and one half days, until the body temperature becomes constant. After removal from the refrigerator the rats remain motionless for about 5 minutes and the operation is performed in that time. An incision is made parallel to and just below the zygomatic arch. The arch is reached by blunt dissection, grasped with fine forceps, freed with a scalpel, and removed. There is almost no bleeding, because circulation is slowed greatly by the cold. The skin is readily approximated and no sutures are necessary, a drop of collodion being ample to keep the wound from gaping. The use of a dissecting microscope greatly facilitates the operation since branches of the seventh nerve and small blood vessels which pass superficial to the arch should be avoided. The rats show no ill effects from the operation and nurse as soon as they have been warmed and returned to their mothers.

RESULTS

Two litters of rats were operated on and subsequently examined at frequent intervals. There were no apparent asymmetries. Therefore, the animals were allowed to grow for 5 months. Then they were sacrificed and the skulls cleaned for study. Of the 6 rats which survived, 3 showed slight deviations toward the normal side. The side from which the arch had been removed apparently grew more rapidly (Pl. 1, figs. 1 and 2). This suggests that the presence of the arch inhibited growth in some way. However, 3 rats showed no asymmetries. A deviation was present only when nearly the whole arch had been removed.

Although the masseter muscle in the rat arises in large part from the maxillary and temporal bones (Howell, 1926 and Greene, 1935), nevertheless removal of as much of the arch as shown in figure 1 does disturb the muscle. Therefore, a second series of operations was performed in which only a small part of the arch was removed.

Eleven animals from two litters were sacrificed at the end of three and one half months. In all cases the arch was interrupted for from one to two millimeters. In contrast to the diverse results of the first experiment, the result in all these

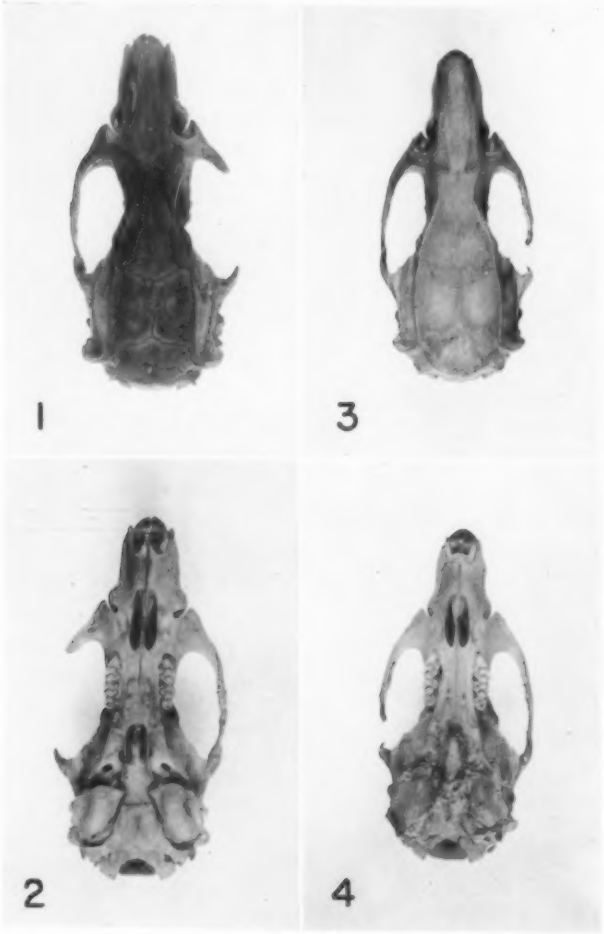

PLATE 1

FIGS. 1 AND 2. Dorsal and ventral views of skull of rat, showing the slight deviation toward the normal side which follows removal of the majority of the zygomatic arch.

FIGS. 3 AND 4. Dorsal and ventral views of skull of rat, showing normal proportions although the zygomatic arch was interrupted on the day of birth.

cases was the same. No asymmetries were encountered (Pl. 1, figs. 3 and 4). From this it was concluded that the asymmetries observed in the first series were incidental to muscular damage and imbalance.

CONCLUSION

The zygomatic arch exerts no direct effect on the form of the skull in the rat. Interruption of the arch produces no asymmetries, unless so much of the arch is removed that the masseter muscle is disturbed.

SUMMARY

The zygomatic arch of newborn rats was removed for various distances. No asymmetries resulted unless so much of the arch was removed that the muscles of mastication were affected.

LITERATURE CITED

BAKER, L. W. 1941. The influence of the formative dental organs on the growth of the bones of the face. Amer. Jour. Orthodontics and Oral Surgery, vol. 27, pp. 489–506.

FICK, L. 1859. Neue Untersuchungen über die Ursachen der Knochenformen. Marburg.

GIBLIN, N. AND A. ALLEY. 1944. Studies in skull growth. Coronal suture fixation. Anat. Rec., vol. 88, pp. 143–153.

GREENE, E. C. 1935. Anatomy of the rat. Trans. Amer. Philos. Soc., no. 27, pp. 1–370.

GRIFFITH, J. Q., JR. AND E. J. FARRIS. 1942. The rat in laboratory investigation. Lippincott, Philadelphia, pp. 1–448.

HOWELL, A. B. 1926. Anatomy of the wood rat. Monograph of the Amer. Soc. Mamm., no. 1, pp. 1–225, Baltimore.

PRATT, L. W. 1943. Masseterectomy in the rat. Jour. Mamm., vol. 24, pp. 204–211.

WIESNER, B. P. 1934. The genital organs in the albino rat. Jour. Obs. and Gyn., British Empire, vol. 41, pp. 867–922.

Department of Anatomy, College of Physicians and Surgeons, Columbia University, New York, New York.

GENERAL NOTES

THE BREEDING HABITS OF THOMOMYS BOTTAE IN ORANGE COUNTY, CALIFORNIA

In 1936 and 1937, the Soil Conservation Service was engaged in rodent control on certain demonstration areas. Near El Toro, Orange County, California, Fred L. Miller was engaged in this work, and under the direction of Project Biologist Merle R. Gross, he kept reasonably accurate, although somewhat incomplete, records of the breeding condition of the female pocket gophers trapped. Most, although not all, of the specimens were taken on unirrigated land. The data obtained from examination of over 1,100 females are presented (Table 1 and Figure 1) in a form similar to that used by Scheffer (Jour. Mamm. 19(2): 220–224, 1938). The observations cover nearly the full breeding cycle, although not for a single season, and the midwinter period is inadequately sampled. It appears that the breeding season must have begun in 1936 about the last part of September, and that it must have ended about the last of May. The samples taken after May 10 are too small to show the exact ending of the season reliably. Two prominent peaks of pregnancy are clearly marked, one about November 1 and the other about April 1.

Scheffer's (*loc. cit.*) figures agree reasonably well with the above. He does not state the year or years in which his observations were made, so it is not known if the differences are because of locality or season or both. It seems very likely that sexual development in the pocket gophers may be rather directly dependent on food. Thus, rainfall, and possibly temperature, may retard or advance the annual cycle in different years; thus, also,

TABLE 1.—*Breeding data on pocket gophers in California*

YEAR	TRAPPING DATES	♂	♀	JUVENILE	PREGNANCY DATA							NUMBER OF EMBRYOS PER FEMALE													AVERAGE PER FEMALE
					Early	Medium	Advanced	Total	Fetal Scars	Lactating	Per cent ♀♀ Pregnant	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
	Mar. 25																									
	Apr. 3	—	12	—	—	—	—	9	—	—	75.0			2		1 (Mar. 25)										4.67
	Apr. 10, 17, 24	—	25	—	—	—	—	9	—	—	36.0		1		1	3			1 (Apr. 17, 24)							5.67
	Apr. 29																									
	May 8	—	20	—	—	—	—	5	—	—	25.0			1	2	2										5.20
	May 15	—	10	—	—	—	—	0	—	—	0.0															
	May 22	—	10	—	—	—	—	0	—	—	0.0															
	May 29	—	10	*	—	—	—	0	—	—	0.0															
	Jun. 5, 12, 19, 27	—	?	—	—	—	—	0	—	—	0.0															
1936	Oct. 12–16	—	20	—	—	—	—	3	—	—	15.4															
	Oct. 19–23	—	45	—	2	7	—	11	2	3	24.4															
	Oct. 26–30	—	50	—	—	—	1	17	1	3	34.0															
	Nov. 2–6	—	122	—	3	24	61	88	19	—	72.1	"3 to 5 (med) 5 to 6 (advanced)"														
	Nov. 9–13	—	89	—	0	0	26	26	12	20	29.2															
	Nov. 17–21	—	69	—	1	0	13	14	—	37	20.3															
	Nov. 23–25	—	41	—	0	0	15	15	—	3	35.7															
	Dec. 1–3	—	54	—	0	0	19	19	—	10	35.2															
	Dec. 7–10	—	57	—	0	0	8	8	—	14	14.1															
	Jan. 5–6	—	42	—	6	0	9	15	1	10	35.7															
	(Feb. 2	—	5	—	2	2	0	4	—	1	80.0)					2		1				1				8.25
	Feb. 15–19	—	70	14	2	23	7	32	12	18	45.7			2	16	13	1									5.41
1937	Feb. 23–26	—	66	13		6	18	24	12	14	36.4			1	9	11	2	1								5.71
	Mar. 2–5	45	79	35	0	12	15	37	8	26	46.8			2	20	6	4	2	1	1	1					5.89
	Mar. 8–12	47	105	30	4	35	13	52	10	27	49.5				6	20	20		2	1	1	1	1			6.81
	Mar. 15–19	78	95	29	1	36	20	57	6	15	60.0				12	24	14	2	1		1		2		1?	6.67
	Total		1096										1	8	66	82	41	7	4	2	3	1	4		1?	

* "6–8 a week." 1369 embryos; 220 pregnant ♀♀; 6.223 embryos/♀.

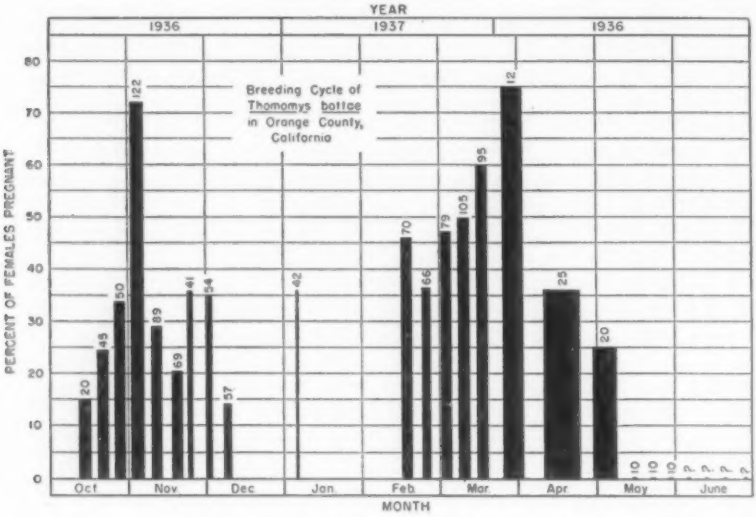

FIG. 1. Percentage of pregnancy in adult females of *Thomomys bottae* trapped in Orange County, California, between March 25, 1936, and March 19, 1937. The width of each rectangle denotes the period in which the corresponding sample was trapped. The number above the rectangle is the number of females in the corresponding sample.

the peaks of pregnancy may be sharpened or flattened according to weather of a particular year. Rainfall may also affect the success of the sexes in meeting and mating by its effect on the "digability" of the soil.—R. M. BOND, *Soil Conservation Service, Portland, Oregon.*

SPEED IN THE LANGUR

Anyone who has observed several genera of Primates in the trees or on the ground realizes how great is the variation in speed of movement. But records of speed among the Primates other than for man are difficult to secure. The langur (*Pithecus*) of Asia is one of the faster members of the order. Langurs run along the branches of large trees with great speed and can outrun or overtake a dog on the level ground. In southeastern Ceylon the Kantali langurs (*Pithecus senex philbricki*) come out of the scrub forest to feed on fruit fallen from the wayside trees and on the grassy slopes of the built-up roadway, or just to sit and sun themselves on the highway. Traffic over most of these highways is very light and most of it consists of people on foot or slow moving ox-drawn carts. When such a group of langurs is overtaken some individuals move into the jungle at once, some climb roadside trees while others, usually adult males, may run along the roadside before taking to the trees. This habit offered us an opportunity to determine the ground speed of the langur. An old male detached himself from one such group, running to one side of and slightly in front of our motor vehicle. He ran thus for almost 70 yards at the astonishing speed of 26 miles per hour. The speedometer used was checked with those of two other military vehicles of different classes: all were within 10 percent of each other. Even though the speed recorded was undoubtedly high, probably it was not more than 10 percent above the true figure. Twenty three miles per hour is no mean accomplishment for any primate!

When pressed while traveling on the ground, adult langurs lope or gallop, holding the back rigid and flat. This movement is much like the lateral gallop of the dog as described

by Howell (Speed in Animals, 1944) except that, unlike the speedy dog with curved rump and arched back the langur does not advance the hind legs as far forward and each cycle includes a half bound. The hips and shoulders move up and down in a "rocking-horse" motion of the short stride and the half bound. This differs from locomotion along large limbs where the shoulders and hips remain parallel to the substratum and the limbs are moved in the diagonal support gait or trot. Progression both along limbs and on the ground in the Indian macaque (*Macacus rhesus*) is somewhat similar, but the speed is not nearly as great as in the langur.—Robert K. Enders, *Edward Martin Biological Laboratory, Swarthmore, Pennsylvania.*

FURTHER NOTES ON BADGERS

Through the courtesy of officials of the Texas Game, Fish and Oyster Commission, five additional records of badgers killed by automobiles on highways in Texas have been made available to me. These supplement the notes by Dexter (Jour. Mamm., vol. 26, no. 1, p. 89, 1945) and Davis (Jour. Mamm. vol. 26, no. 1, p. 89, 1945). These records are as follows: Bee County, August 14, 1942 (C. W. Glazener); Dimmit County, July 17, 1941 (observer not recorded); Duval County, August 11, 1940 (V. W. Lehmann); La Sallê County, December 7, 1940 (T. Dawson); Tom Green County, August 15, 1940 (E. A. Walker). All of these animals were found within the range of *Taxidea taxus berlandieri* and doubtless represent that subspecies.

Perhaps of some significance is the fact that eight of the nine mortalities thus far recorded occurred from July 16 to August 31. This period coincides with the breeding season of badgers. Davis (Jour. Mamm., vol. 25, no. 3, p. 264, 1944) reported the observation of two badgers found copulating on July 20, 1940. Perhaps the high incidence of mortality reflects an increased tendency for badgers to wander during that period in search of the opposite sex. The sex of only four of the animals was recorded—two males and two females, suggesting that the female is as active as the male in seeking a mate.

Seton (Lives of Game Animals) states that he thinks badgers are monogamous, mate for life, and remain together throughout the year. He cites as evidence the fact that badgers have been seen together in summer and early fall. As pointed out above, this is the period of mating. My own observations lead me to conclude that badgers mate for only a brief period and that the male leads a solitary life throughout the remainder of the year; the female alone rears and provides for her family.—William B. Davis, *Department of Fish and Game, College Station, Texas.*

THE BLACK PERSIMMON AS A SUMMER FOOD OF THE TEXAS ARMADILLO

From August 14 to 17, 1942, the writer visited Camp Bullis, a 30,000 acre military reservation 16 miles north of San Antonio, Texas, to determine the vertebrate hosts of the Lone Star Tick, *Amblyomma americanum*. This survey was made with Dr. James M. Brennan who had studied the tick problem since early June 1942.

Among the mammals collected and observed as possible hosts of the tick were a number of nine-banded armadillos, *Dasypus novemcinctus texanus*. These mammals were unusually abundant on the reservation. Routine examination of armadillo stomachs were made in the field and a number preserved for further study. All of the eight stomachs examined revealed a high incidence of the pulpy fruit and seeds of the black persimmon or chapote, *Diospyros texana*. Armadillos could be observed in the live oak and brushy persimmon thickets during the hottest part of the day as well as the evening hours, when most of the collecting was done. The impression of field observation and stomach analysis suggest this is a most important food item at this season, accounting for more than 80 percent of the stomach contents. In his excellent account of the food of the Texas Armadillo, Kalmbach (The Armadillo: Its relation to Agriculture and Game. Game, Fish and Oyster Comm., Austin, Texas, 1944) records berries and fruits in only 2.1 percent of 169 stomachs. No August specimens were examined by Kalmbach.—W. J. Hamilton, Jr., *Cornell University, Ithaca, N. Y.*

ABNORMALITY IN DENTITION OF MYOTIS LUCIFUGUS

This is to record an abnormality in the dentition of *Myotis lucifugus lucifugus* (LeConte) from northern West Virginia. Miller (North Amer. Fauna, no. 13, 1897, p. 82.) has shown that the posterior of the two smaller upper premolars in *M. thysanodes* may be crowded and drawn inward from the tooth row. Miller and Allen (U. S. Nat. Mus., Bull. 144, 1928, pp. 7–8.) state that there is a decided tendency toward the loss of this tooth in *M. occultus* and that occasional individuals of other species may lack one of these teeth; however, they do not cite examples of this condition in *M. lucifugus*.

During August 1943, I shot a male *M. l. lucifugus* (no. 109) at Cheat Lake, Monongalia Co., West Virginia. Upon examination of the skull it was found that both of the upper second premolars (pm^2) were missing. I sent the specimen to Mr. J. Kenneth Doutt, Carnegie Museum, to verify my identification. Mr. Doutt, being somewhat puzzled by the condition, later took it to the United States National Museum. Quoting from his letter of June 10, 1944: "At the National Museum the opinion seemed to be that it (no. 109) was a typical *Myotis*, but that it lacked the premolars on both sides . . . I am fairly well convinced that it is a *Myotis*, which, for some reason or other, has never developed the premolars."

Examination of 32 male and 43 female *M. l. lucifugus* that I have prepared from four localities on Cheat River in West Virginia (extremes approximately 35 airline miles apart) show that 6 males and 8 females have some abnormality with regard to the upper smaller premolars. Five specimens were shot over Cheat Lake, Monongalia Co., during July, August, and September 1943; 5 were taken from a small cave near Cheat Lake during March and October 1945; 20 were taken from Cornwall's Cave, Preston Co., during August 1944 and April 1945; and, 45 were collected for me by Mr. C. C. Holbert from the attic of a dwelling house at Parsons, Tucker Co., during May, June, and August 1945.

Pm^2, on both sides, is missing in one Monongalia Co. male (no. 109), in one Preston Co. female (no. 254), and in three Tucker Co. females (nos. 280, 309, and 318). The right pm^2 is missing in one Tucker Co. male (no. 311); and, the left pm^2 is missing in two Tucker Co. females (nos. 275 and 310). These teeth are appreciably crowded toward the inside of the tooth row in two females and one male from Tucker Co. (nos. 269, 291, and 312), and in two Preston Co. males (nos. 203 and 207). One Tucker Co. male (no. 308) has both pm^2 noticeably reduced in size. The teeth of the lower jaws of these specimens are essentially normal.

All skulls have been examined with a binocular microscope and show no indication of the teeth having been lost or broken off in cleaning. Mr. Doutt has verified the identification and the tooth condition of four of the specimens showing complete absence of the smaller upper premolars. All specimens, excepting no. 109 which is in the Carnegie Museum, are in my collection.—W. Gene Frum, *425 High Street, Morgantown, West Virginia.*

CORONARY SYSTEM OF VEINS OF HEART OPENING INTO LEFT ATRIUM BY A NORMAL THEBESIAN ORIFICE

Feldstein and Pick (Amer. Jour. clinical Path., vol. 12, pp. 66–69, 1942) give several examples of the coronary system ending in the left atrium in humans. In these reports the concomitant appearance of a persistent left precava (left superior vena cava) is noted. The discussion centers upon this as a possible causative element. But since the left precava is preserved in so many mammals, and without any note of even an occasional concomitant ending of the coronary system in the left atrium, we may question the relation. However, there is so little opportunity of knowing whether there are instances of the left atrial termination of coronary system in other mammals that this note is offered to suggest further observations.

The writer has studied many sheep and dog hearts. In none was such an arrangement found. In man, two definite occurrences in human hearts are reported (Anat. Rec., vol. 85, no. 3, p. 21, 1943) and the writer is of the opinion that a search among general mammalian types might be rewarded. In man, the ostium of the coronary system varies in locus within the right atrium, and is rarely if ever near the interatrial septum, although

Parker and Haswell (Zoology, ed. 3, pp. 449, 558, 1921) say the ostium is in the lower left corner of the right atrium. In the latter event the removal of the ostium to the left atrium might be explained.

If in insectivores, rodents and ungulates some instances occur, the explanation of such formations in man would become reasonably easier.—Thomas H. Evans, *350 South Main Street, Freeport, New York.*

A NEW COUNTY RECORD FOR THE OHIO SHREW

The Ohio shrew, *Sorex cinereus ohionensis*, was described as a new subspecies by Bole and Moulthrop (Sci. Pub. of Cleveland Mus. of Nat. Hist. 5(6):89–95, 1942.). A total of 178 specimens and 3 owl pellet records collected from 8 counties in northeastern Ohio were studied by them. The only records from Summit County were 2 skeletons recovered from owl pellets. A specimen has since been collected from that county. On August 28, 1943, the writer with a class of students found a female Ohio shrew lying dead on a grassy path in a field at Munroe Falls, Summit County, at 9 a.m. The specimen bore no injury and was fresh: neither rigor mortis nor disintegration had set in. This record is the southernmost one yet known, and was collected 25 miles due south of the type locality (Hunting Valley). One ovary measured 5.31 x 2.78 mm. and contained groups of large follicles. The other ovary was very small. In the stomach were found insect mandibles, antennae, legs, trachea and the head of a wireworm larva. The specimen was identified by Dr. H. H. T. Jackson and deposited in the U. S. Biological Surveys mammal collection.—Ralph W. Dexter, *Department of Biology, Kent State University, Kent, Ohio.*

INFLUX OF BEARS INTO ST. LOUIS COUNTY, MINNESOTA

Having read of an unusual number of black bears (*Euarctos a. americanus*) in the vicinity of Duluth, Minnesota, I wrote to W. H. Borgen, County Auditor, for the number presented for bounty. Under date of October 2, 1945, he wrote as follows: "We wish to advise you that to date applications involving 157 adult bears and 77 cubs have been received covering St. Louis County." An immigration of this magnitude is noteworthy. A request for an opinion on the cause of the movement brought the reply that there was a shortage of berries and other wild fruits.

The state bounty is $20.00 for an adult bear and $10.00 for a cub. In Chapter 350 of the laws of Minnesota for 1945, a cub is defined as follows: "All bears shall be considered cubs until after they have emerged from their second period of hibernation." Under this definition a bear would not become an adult until it was at least 26 months of age. I was unable to learn definitely if any of the adult females were accompanied by yearlings.—A. W. Schorger, *168 N. Prospect Ave., Madison, Wisconsin.*

OBELISCOIDES CUNICULI FROM THE WOODCHUCK IN OHIO AND MICHIGAN

Obeliscoides cuniculi has previously been reported from the woodchuck (*Marmota monax*) from Missouri (Twichell, 1939) and from Minnesota (Wallace, 1942). In Missouri the parasite was found in 2 of 19 woodchucks examined, and in all of 6 examined in Minnesota.

Seven of 15 woodchucks (46.6%) from central Ohio were infected, the number of parasites varying from 10 to 61, averaging 24. It is of interest that of 14 cottontail rabbits collected from the same area in Ohio, only 3 (21.4%) were infected, although LeDune (1934) found 92.8% of 126 specimens, collected in 40 counties, to be infected with this parasite.

Two woodchucks, both collected at East Lansing, Michigan, during the summer of 1945, were infected, containing 10 and 17 specimens, respectively. Two of 3 cottontail rabbits collected from the same woodland area were infected, containing 21 and 1 specimens.

Apparently the woodchuck is a common host for this parasite. An examination of a large number of these animals would be of interest to show how the percentage of infection compares with that of rabbits, long considered the only natural host.

LITERATURE CITED

LeDuke, E. K. 1934. A survey of the parasites infecting the wild rabbit, *Sylvilagus floridanus*, of Ohio. Proc. 27th Conv. of Int. Assoc. of Game, Fish, and Cons. Comm.

Twichell, A. R. 1939. Notes on the southern woodchuck in Missouri. Jour. of Mamm., vol. 20, pp. 71–74

Wallace, F. G. 1942. The stomach worm, *Obeliscoides cuniculi*, in the woodchuck. Jour. Wildlife Mgt., vol. 6, pp. 92.

Robert Rausch and Jack Tiner, *Michigan State College, East Lansing, Michigan.*

MISCELLANEOUS NOTES

Just as dawn was breaking on the morning of September 6, 1944, the writer found on a pier in the James River here a pair of red bats, *Lasiurus borealis*, in copulation. This may throw light on period of gestation.

In the course of examining approximately 600 mink stomachs, the writer found one distended by giant red kidney worms, *Dioctophyme renale*. Between the outer and inner walls of the stomach these parasites had caused to develop a supporting concretion, suggestive of a pseudo-skeleton.

The photographs (upper left) show the empty stomach with the concretion partly exposed, the worms just as they were rolled out, and (upper right) the concretion after it was cleaned.

The skull of a snowshoe rabbit, *Lepus americanus*, (lower photograph), was nicely cleaned by the digestive tract of a wildcat, as the attached label indicates.—Ned Dearborn, *Hilton Village, Virginia.*

GUINEA WORM INFESTATION OF RACCOONS IN NEW HAMPSHIRE

During 1945 I had occasion to examine four raccoons (*Procyon lotor lotor*), one in April, one in May, and two in September. The two specimens examined in spring were parasitized with guinea worms (*Dracunculus insignis*) (Leidy 1858). In both cases the worms were imbedded beneath the skin in the musculature of the hind legs. One raccoon had both legs parasitized while the other had three worms in one leg. Chandler (Amer. Jour. Tropical Medicine, vol. 22, no. 2, 1941) found this round worm to be fairly common in raccoons of eastern Texas. To my knowledge, however, it has not been recorded previously from New Hampshire.—HILBERT R. SIEGLER, *Fish and Game Department, Concord, New Hampshire.*

RECENT LITERATURE

(Conducted by Gerrit S. Miller, Jr., Remington Kellogg, and Emma M. Charters)

[Reprints of this section may be purchased from the Corresponding Secretary.]

ABBOTT, JACOB BATES. Fur-bearing dynamite—the fisher. Pennsylvania Game News, Harrisburg, vol. 16, no. 2, pp. 4–5, 22, illus. May, 1945.

ALDOUS, C. M. A winter study of mule deer in Nevada. Jour. Wildlife Management, Menasha, vol. 9, no. 2, pp. 145–151. April, 1945.

ANDERSON, RUDOLPH MARTIN. Summary of Canadian black bears with description of two new northwestern species. Ann. Rept., Provancher Soc. Nat. Hist. Canada, Quebec, 1944, pp. 17–33. 1944. (New: *Euarctos randi, E. hunteri.*)

——— Three mammals of the weasel family (Mustelidae) added to the Quebec list with descriptions of two new forms. Ann. Rept., Provancher Soc. Nat. Hist. Canada, Quebec, 1944, pp. 56–61. 1944. (New: *Mustela vison lowii, Lutra canadensis chimo.*)

ANONYMOUS. The American mink. South Dakota Conservation Digest, Pierre, vol. 12, no. 3, p. 13. March, 1945.

——— Master whitetail. Texas Game and Fish, Houston, vol. 3, no. 4, pp. 5–6, 14, illus. March, 1945.

——— Little is known about breeding otters. Fur of Canada, Winnipeg, vol. 10, no. 1, p. 18. April, 1945.

——— Orphan otter found on DeKalb stream. Outdoor Georgia, Atlanta, vol. 5, no. 30, p. 7, illus. April 1, 1945.

——— Bobcats aid farmers by helping control rabbits. Science News Letter, Washington, vol. 47, no. 16, p. 248. April 21, 1945.

——— Quail hunter at home, tiger killer in India. Alabama Conservation, Montgomery, vol. 16, no. 11, p. 9. May, 1945. (Bengal tiger, 9 feet, 6 ¼ inches in length, more than 500 pounds in weight.)

——— Mother hedgehog and her young. Nat. Hist., New York, vol. 54, no. 5, p. 199, illus. May, 1945.

——— GI pets—some are aliens. Outdoor Indiana, Indianapolis, vol. 12, no. 4, pp. 2–3, illus. May–June, 1945.

——— Deer in Madison. Outdoor Indiana, Indianapolis, vol. 12, no. 4, p. 15. May–June, 1945.

——— Logan deer poses on tipple roof. West Virginia Conservation, Charleston, vol. 9, no. 4, p. 11, illus. July, 1945.

——— The badger in Ohio. Ohio Conservation Bull., Columbus, vol. 9, no. 7, p. 27. July, 1945.

ANTHONY, H. E. [Review of] The wolves of North America, by Stanley P. Young and E. A. Goldman. Nat. Hist., New York, vol. 54, no. 3, p. 101. March, 1945.

BACSICH, P., and G. M. WYBURN. Induction of heat in spayed female guinea pigs by sub-

cutaneous hormonal implants. Nature, London, vol. 155, no. 3936, p. 430. April 7, 1945.

BARKER, ELLIOTT S. Coyotes and the luxury tax. New Mexico Mag., Santa Fe, vol. 23, no. 4, pp. 21–22. May, 1945.

BARNES, WILLIAM B. The white-tailed deer in Indiana. Outdoor Indiana, Indianapolis, vol. 12, no. 2, pp. 4–5, 16, illus. March, 1945.

BARRIOL, A. International whaling statistics Antarctic 1938–1939. Jour. Soc. Statistique Paris, Année 81, no. 5, pp. 106–109. December, 1940.

BASSETT, CHARLES F., OLIVER P. PEARSON, and EDWARD MARTIN. Mating fox vixens for maximum productivity. Fur of Canada, Winnipeg, vol. 10, no. 5, pp. 22–23, February 1945; Nat. Fur News, Denver, vol. 17, no. 2, pp. 6, 20, March 1945.

BASSETT, CHARLES F. Progress at the U. S. fur animal experimental station. Fur of Canada, Winnipeg, vol. 10, no. 1, p. 22. April, 1945.

BEACH, FRANK A. Bisexual mating behavior in the male rat: Effects of castration and hormone administration. Physiological Biol., Chicago, vol. 18, no. 4, pp. 390–402. October, 1945.

BECKETT, EVA. White whales. Canadian Nature, Toronto, vol. 7, no. 2, p. 44, illus. March–April, 1945.

BEEMAN, ELIZABETH A., and W. C. ALLEE. Some effects of thiamin on the winning of social contacts in mice. Physiological Zool., Chicago, vol. 18, no. 2, pp. 195–221. April, 1945.

BLAKE, FRANCIS G., KENNETH F. MAXCY, JOSEPH F. SADUSK, JR., GLEN M. KOHLS, and E. JOHN BELL. Trombicula fletcheri Womersley and Heaslip 1943, a vector of Tsutsugamushi disease (scrub typhus) in New Guinea. Science, Lancaster, n. s., vol. 102, no. 2638, pp. 61–64. July 20, 1945. (*Echymipera, Rattus, Melomys*, and *Uromys* were hosts.)

BOOTH, ERNEST S. Corynorhinus in northeastern Oregon. Murrelet, Seattle, vol. 26, no. 2, p. 26. May–August (August 10), 1945.

———— A new red-backed mouse from Washington state. Murrelet, Seattle, vol. 26, no. 2, pp. 27–28. May–August (August 10), 1945. (New: *Clethrionomys gapperi cascadensis*.)

BOWNESS, E. RENDLE Mink mating problems. Fur-Fish-Game, Harding's Mag., Columbus, vol. 79, no. 7, pp. 28–30. July, 1945.

———— The rising star of wild mink. Nat. Fur News, Denver, vol. 17, no. 3, pp. 5, 18–19. April, 1945.

BRADLEY, W. Z. Woodchuck defense. Pennsylvania Game News, Harrisburg, vol. 15, no. 12, pp. 11, 28, illus. March, 1945.

BRONGERSMA, L. D., and G. C. A. JUNGE. On the variation of Mustela (Lutreola) nudipes Desm. Zool. Mededeel., Leiden, vol. 23, nos. 3–4, pp. 149–170, fig. 1, pls. 5–8. 1942.

BROOM, R. Age of the South African ape-man. Nature, London, vol. 155, no. 3935, pp. 389–390. March 31, 1945.

BRUSH, HELEN VIOLA. The effects of thyroxin and stilbestrol on healing of fractures in the rat. Amer. Jour. Anat., Philadelphia, vol. 76, no. 3, pp. 339–373, figs. 5, pls. 3. May, 1945.

BRYANT, HERWIL M. Biology at East Base, Palmer Peninsula, Antarctica. Proc. Amer. Philos. Soc., Philadelphia, vol. 89, no. 1, pp. 256–269, figs. 29. April 30, 1945. (Seals, pp. 268–269.)

BUGBEE, ROBERT E., and ANDREW RIEGEL. Seasonal food choices of the fox squirrel in western Kansas. Trans. Kansas Acad. Sci., Lawrence, vol. 48, no. 2, pp. 199–203, figs. 4. September, 1945.

BURLINGAME, EMILY. One of my best friends. San Diego Zoonooz, vol. 18, no. 4, p. 4. April, 1945. (Wart hog.)

BURTON, R. W. Wild dogs attacking a tiger. Jour. Bombay Nat. Hist. Soc., vol. 45, no. 2, p. 232. April, 1945.

BUTLER, RALPH E. The blue cow. Alaska Sportsman, Ketchikan, vol. 11, no. 4, pp. 8–9, 33–41, illus. April, 1945. (*Sibbaldus musculus.*)

——— Right whales and wrong whales. Alaska Sportsman, Ketchikan, vol. 11, no. 5, pp. 12–13, 25–31, illus. May, 1945.

CAHALANE, VICTOR H. The moose. Cranbrook Inst. Sci. News Letter, Bloomfield Hills, vol. 14, no. 7, pp. 70–74. March, 1945.

CALDWELL, J. B. Getting the big game. Alaska Sportsman, Ketchikan, vol. 11, no. 4, pp. 14–15, 24–27, illus. April, 1945.

CAMPBELL, C. L. Control of diseases of foxes. Nat. Fur News, Denver, vol. 17, no. 2, pp. 7, 14–15, 22–23. March, 1945.

CAMPBELL, J. E. The weasels of North Dakota. North Dakota Outdoors, Bismarck, vol. 7, no. 9, pp. 13–14, illus. March, 1945.

CARR, WILLIAM H. Raccoons we have known. Nat. Hist., New York, vol. 54, no. 4, pp. 152–157, illus. April, 1945.

CASTLE, W. E. Dr. Osborn's experiments with mink mutations. Amer. Fur Breeder, Duluth, vol. 17, no. 9, p. 18. March, 1945.

CHAMPION-JONES, R. N. Occurrence of the lion in Persia. Jour. Bombay Nat. Hist. Soc., vol. 45, no. 2, p. 230. April, 1945.

CODY, LORA B. Brown bear on the beach. Alaska Sportsman, Ketchikan, vol. 11, no. 4, pp. 10–11, 29–33, illus. April, 1945.

COLBY, ALFRED L. Mink ranching and its possibilities. Fur-Fish-Game, Harding's Mag., Columbus, vol. 79, no. 4, pp. 30–31, illus. April, 1945.

COTTAM, WALTER P., and FREDERICK R. EVANS. A comparative study of the vegetation of grazed and ungrazed canyons of the Wasatch Range, Utah. Ecology, Lancaster, vol. 26, no. 2, pp. 171–181. April, 1945.

CRANDALL, LEE S. News from the nursery. Animal Kingdom, New York, vol. 48, no. 2, pp. 27–31, illus. March–April, 1945. (Lion, tiger, black leopard cubs.)

CROW, A. H. The war, the 20 percent tax, and the fur business. Nat. Fur News, Denver vol. 17, no. 3, pp. 6, 21. April, 1945.

CUÉNOT, LUCIEN. Les antinomies de la biologie. Rev. Sci. (Revue Rose Illus.), Paris, no. 2, pp. 85–96, figs. 11. February, 1941.

CURRAN, C. H. Ticks—a menace to animal life. Nat. Hist., New York, vol. 54, no. 5, pp. 212–215, illus. May, 1945.

DALE, BONNYCASTLE, JR. Release from winter's bondage. Rod & Gun in Canada, Montreal, vol. 46, no. 9, pp. 10–11, illus. March, 1945. (Rabbits, moose, bears, muskrats.)

DARLING, J. N. "DING". Poverty or conservation. III. Conservation Volunteer, St. Paul, vol. 8, no. 45, pp. 44–48. March–April, 1945.

DARROW, ROBERT W. Fox food habits. Western New York Conservationist, Buffalo, vol. 5, no. 5, pp. 10, 11. May, 1945.

DAVIS, DAVID E. The control of rat fleas (Xenopsylla cheopsis) by DDT. U. S. Publ. Health Repts., Washington, vol. 60, no. 18, pp. 485–489. May 4, 1945.

DAVIS, WILLIAM B. Texas skunks. Texas Game and Fish, Austin, vol. 3, no. 8, pp. 8–11, 25–26, illus. July, 1945.

DENMEAD, TALBOTT. Importations of live birds and animals. Pennsylvania Game News, Harrisburg, vol. 15, no. 12, pp. 10, 31. March, 1945.

DEOME, K. B. A new recessive lethal mutation in mice. Univ. California Publ. Zool., Berkeley, vol. 53, no. 2, pp. 41–55, figs. 3, pls. 2. August 16, 1945.

DITTOE, GEORGIA. Sweedy, a character study. San Diego Zoonooz, vol. 18, no. 4, p. 5. April, 1945. (Wart hog.)

——— A pig by another name. San Diego Zoonooz, vol. 18, no. 5, pp. 3–4, illus. May, 1945. (Babirusa.)

DODGE, NATT N. Modern inhabitants of prehistoric Casa Grande. Nat. Parks Mag., Washington, no. 80, pp. 15–18, illus. January–March, 1945. (Bats.)

DOUGLASS, DONALD W., and G. W. BRADT. The red fox—friend or foe? Michigan Conservation, Lansing, vol. 14, no. 5, pp. 7–8, illus. May, 1945.

DRURY, LLOYD. How to produce a prolific strain of marten. Amer. Fur Breeder, Duluth, vol. 18, no. 3, pp. 42, 44. September, 1945.

DURRANT, STEPHEN D., and HENRY W. SETZER. The distribution and taxonomy of kangaroo rats (genus Dipodomys) of Utah. Bull. Univ. Utah, Salt Lake City, vol. 35, no. 26, pp. 39, figs. 2, maps 4. June 30, 1945. (New: *Dipodomys ordii fremonti, D. o. pallidus, D. o. sanrafaeli, D. o. uintensis.*)

EAST, BEN. Possums are duds. Field and Stream, New York, vol. 49, no. 12, pp. 14–15, 65–71, illus. April, 1945.

EATON, THEODORE H., JR. Why do animals become extinct. Fauna, Philadelphia, vol. 7, no. 2, pp. 45–47, illus. June, 1945.

EDMINSTER, FRANK C. Ditching for muskrats. Pennsylvania Game News, Harrisburg, vol. 16, no. 1, p. 13, illus. April, 1945.

EISELEY, LOREN C. The mastodon and early man in America. Science, Lancaster, n. s., vol. 102, no. 2640, pp. 108–110. August 3, 1945.

ELLEY, W. B. What makes a bad coyote bad. South Dakota Conservation Digest, Pierre, vol. 12, no. 3, p. 16. March, 1945.

——— Coyote pup hunting. South Dakota Conservation Digest, Pierre, vol. 12, no. 5, pp. 13, 16. May, 1945.

ELWELL, NISKA. I married a head hunter. Outdoorsman, Chicago, vol. 87, no. 2 (whole no. 513), pp. 16–17, 49, illus. March–April, 1945. (Hunting in Alaska.)

EVANS, F. GAYNOR, and VERNON E. KRAHL. The torsion of the humerus: A phlogenetic survey from fish to man. Amer. Jour. Anat., Philadelphia, vol. 76, no. 3, pp. 303–337, figs. 5. May, 1945.

FLETCHER, H. O. Palorchestes—Australia's extinct giant kangaroo. Australian Mus. Mag., Sydney, vol. 8, no. 11, pp. 361–365, illus. May 31, 1945.

FRASER, F. C. On a specimen of the southern bottle-nosed whale, Hyperoodon planifrons. Discovery Reports, Cambridge, vol. 23, pp. 19–36, figs. 11. March, 1945.

GATES, CLAYTON G. Trapping weasel. Fur-Fish-Game, Harding's Mag., Columbus, vol. 79, no. 7, pp. 38–39. July, 1945.

GOODWIN, GEORGE G. Four new rodents from Costa Rica. Amer. Mus. Novitates, New York, no. 1293, p. 3. July 20, 1945. (New: *Reithrodontomys mexicanus potrerograndei, R. harrisi, Oryzomys fulvescens creper, O. f. reventazoni.*)

GORE, CYRIL. Wearing of teeth in tiger. Jour. Bombay Nat. Hist. Soc., vol. 45, no. 2, pp. 230–231. April, 1945.

GRAHAM, LILLIAN S., and MARJORIE WACKERBARTH. About the albinos. Frontiers, Lancaster, vol. 9, no. 4, pp. 105–106, 120, illus. April, 1945.

GRANIT, RAGNAR. Isolation of the mammalian colour receptors with micro-electrodes. Nature, London, vol. 155, no. 3946, pp. 711–713. June 16, 1945.

GREEN, ROBERT G. Control of distemper in foxes. Fur of Canada, Winnipeg, vol. 10, no. 8, pp. 10, 18–19. May, 1945.

GROMOV, V. Twenty-five years of study of the Quaternary of the U.S.S.R. (Translator, M. K. Elias.) Amer. Jour. Sci., New Haven, vol. 243, no. 9, pp. 492–516. September, 1945.

GRUBBS, CLARENCE S. How to mate mink successfully. Nat. Fur News, Denver, vol. 17, no. 2, pp. 5, 12–13, 18–19. March, 1945.

——— Care of mink in April. Nat. Fur News, Denver, vol. 17, no. 3, pp. 7, 20, 26. April, 1945.

GUNN, C. K. Genetics of some new type foxes. Fur of Canada, Winnipeg, vol. 10, no. 6, pp. 8–14. March, 1945.

——— Treatment of anaemia in mutant fox pups. Nat. Fur News, Denver, vol. 17, no. 3, pp. 8, 15, 26. April, 1945.

——— Cutting of fox tendons. Fur of Canada, Winnipeg, vol. 10, no. 8, p. 23. May, 1945.

HADDOW, ALEXANDER, L. A. ELSEN, EDNA M. F. ROE, K. M. RUDALL, and G. M. TIMMIS. Artificial production of coat colour in the albino rat, its relation to pattern in the growth of hair. Nature, London, vol. 155, no. 3935, pp. 379–381, illus. March 31, 1945.

HAHN, HENRY C., JR. Mobility of hill country deer. Texas Game and Fish, Austin, vol. 3, no. 8, p. 17. July, 1945.

HALE, C. W. Colour and growth of hair in rabbits. Nature, London, vol. 155, no. 3944, pp. 670–671. June 2, 1945.

HALL, E. RAYMOND. Dental caries in wild bears. Trans. Kansas Acad. Sci., Lawrence, vol. 48, no. 1, pp. 79–84, pls. 4. June, 1945.

HANKIN, DAN. Arizona united predator control. Arizona Wildlife and Sportsman, Tucson, vol. 6, no. 6, p. 14. April, 1945.

HARDY, ROSS. Dermestid beetles for cleaning skulls and skeletons in small quantities. Turtox News, Chicago, vol. 23, no. 4, pp. 69–70. April, 1945.

——— The taxonomic status of some chipmunks of the genus Eutamias in southwestern Utah. Proc. Biol. Soc. Washington, vol. 58, pp. 85–88. June 30, 1945.

HARLAN, JAMES R. '44 fur harvest $2,000,000. [Iowa.] Iowa Conservation Notes, State Conservation Commission, Des Moines, March 8, 1945.

HARRIS, LORIN E., C. F. BASSETT, S. E. SMITH, and E. D. YEOMAN. The calcium requirement of growing foxes. Fur of Canada, Winnipeg, vol. 10, no. 1, pp. 3–5. April, 1945.

HENDLEY, JOHN R. Successful muskrat trapping. Fur-Fish-Game, Harding's Mag., Columbus, vol. 79, no. 4, pp. 38–39. April, 1945.

HENDRICKSON, GEORGE O. Garden protection from rabbits. Iowa Conservationist, Des Moines, vol. 4, no. 5, pp. 131, 133. May 15, 1945.

HILL, GRADY. Game in the Big Bend. Texas Game and Fish, Austin, vol. 3, no. 8, pp. 11, 22, illus. July, 1945.

HILL, JOHN ERIC. Animal baby carriages. Nat. Hist., New York, vol. 54, no. 5, p. 198, illus. May, 1945.

HIXON, C. GRAHAM. The existence of wildlife as something to expect too often taken for granted. Alabama Conservation, Montgomery, vol. 16, no. 12, pp. 6, 12, 14, illus. June, 1945.

HOAR, WILLIAM S. Repair of fractured deer bones. Acadian Nat., Fredericton, vol. 2, no. 5, pp. 44–46, pl. 3. May, 1945.

HOULIHAN, RALPH B., and W. ANSELL DERRICK. Infectious myxomatosis in malnourished rabbits. Science, Lancaster, vol. 101, no. 2623, p. 364. April 6, 1945.

HUEY, LAURENCE M. The pocket gophers of Baja California, Mexico, with descriptions of nine new forms. Trans. San Diego Soc. Nat. Hist., vol. 10, no. 14, pp. 245–268, 1 map. August 31, 1945. (New: *Thomomys bottae cunicularius*, *T. b. affinis*, *T. b. juarezensis*, *T. b. jojobae*, *T. b. xerophilus*, *T. b. siccovallis*, *T. b. sanctidiegi*, *T. b. proximarinus*, *T. b. borjasensis*.)

——— A new wood rat, genus Neotoma, from the Viscaino desert region of Baja California, Mexico. Trans. San Diego Soc. Nat. Hist., vol. 10, no. 16, pp. 307–310. August 31, 1945. (New: *Neotoma lepida molagrandis*.)

JACKSON, BUD. Big game by proxy. Outdoorsman, Chicago, vol. 87, no. 3 (whole no. 514), pp. 16–17, 50–51, illus. May–June, 1945.

JACOBSEN, W. C. The bounty system and predator control. California Fish and Game, San Francisco, vol. 31, no. 2, pp. 53–63. April, 1945.

JUNGE, G. C. A. A remarkable double tusk of a Sumatran elephant. Zool. Mededeel., Leiden, vol. 23, pp. 2, fig. 1. 1941.

KELLOGG, CHAS. E. Future of commercial rabbit production. Nat. Fur News, Denver, vol. 17, no. 2, p. 8. March, 1945.

KELLOGG, REMINGTON. Macaques. [pp. 113–134] IN: S. D. Aberle, "Primate Malaria", Office of Medical Information, Div. Medical Sci., Nat. Research Council, Washington, pp. [3] + 171, pls. 12. March, 1945.

——— Two new Philippine rodents. Proc. Biol. Soc. Washington, vol. 58, pp. 121–124. September 20, 1945. (New: *Rattus rattus umbriventer*, *Chrotomys whiteheadi mindorensis*.)

KREFTING, LAURITS, and ALTON BRAMER. Wildlife conservation at Grand Portage. Conservation Volunteer, St. Paul, vol. 8, no. 45, pp. 16–18. March–April, 1945.

LABISKY, WALLACE R. Prairie dwellers of the middle border. Fur-Fish-Game, Harding's Mag., Columbus, vol. 79, no. 5, pp. 26–27. May, 1945. (Jack-rabbit.)

LARSON, CARL L. Immunization of white rats against infections with *Pasteurella tularensis*. U. S. Publ. Health Repts., Washington, vol. 60, no. 26, pp. 725–734. June 29, 1945.

LAY, DANIEL W. Big plans for the big horn. Texas Game and Fish, Austin, vol. 3, no. 8, p. 23. July, 1945.

LONGSDORF, H. E. Report of predator control program in Burlington County (N. J.). Amer. Field, Chicago, vol. 143, no. 26, p. 507. June 30, 1945.

LOWERY, GEORGE H., JR. Distribution of Louisiana mammals with respect to the physiography of the state. Proc. Louisiana Acad. Sci., Baton Rouge, vol. 8, pp. 63–73, figs. 2. December 30, 1944.

LUTTRINGER, LEO A., JR. The odds were against him. Pennsylvania Game News, Harrisburg, vol. 15, no. 12, pp. 12–13, 26. March, 1945. (Beaver.)

MAHAFFEY, JUANITA. Wichita wonderland! Oklahoma Game and Fish News, Oklahoma City, vol. 1, no. 6, pp. 6–8, 16, illus. June, 1945.

MAY, JOHN B. Why we should protect the beaver in Massachusetts. Bull. Massachusetts Audubon Soc., Boston, vol. 29, no. 3, pp. 93–95. April, 1945.

MATTINGLEY, A. H. E. Bats and vibrations. Victorian Nat., Melbourne, vol. 61, no. 11, pp. 202–203. March, 1945.

MCCOWAN, DAN. Outgrown bear. Beaver, Winnipeg, outfit 275, pp. 8–10, illus. March, 1945. (Grizzly.)

MCDOUGALL, ELLIS. Big Bend beaver. Fur-Fish-Game, Harding's Mag., Columbus, vol. 79, no. 7, pp. 34–36. July, 1945.

MCKEAN, WM. T. The northern Black Hills deer feeding program. South Dakota Conservation Digest, Pierre, vol. 12, no. 5, pp. 10–11. May, 1945.

MILLER, RICHARD G. Food habits of Yosemite mammals as indicated by their teeth. Pt. 2. Flesh eating mammals (Carnivora). Yosemite Nature Notes, vol. 24, no. 3, pp. 46–48, illus. March, 1945.

MOHR, CHARLES E. Descent to the underworld. Fauna, Philadelphia, vol. 7, no. 1, pp. 2–10, illus. March, 1945. (Bats, woodrats.)

MOORE, GEORGE C. Cahaba River basin. Alabama Conservation, Montgomery, vol. 16, no. 9, pp. 9, 14, illus. March, 1945. (Wildlife potentialities.)

MORRIS, R. F. On skunks and how to remove them. Acadian Nat., Fredericton, vol. 2, no. 5, pp. 34–39, pl. 2. May, 1945.

MUENCH, JOYCE, and JOSEF MUENCH. The California mule deer. Nat. Hist., New York, vol. 54, no. 3, pp. 110–112, photos. March, 1945.

NAGEL, W. O. Controlling muskrat damage in ponds. Missouri Conservationist, Jefferson City, vol. 6, no. 4, pp. 10–11. April, 1945.

NELSON, HAZEL E. A cougar in the house. Nature Mag., Washington, vol. 38, no. 3, pp. 146–147, 164, illus. March, 1945.

NUSBAUM, JESSE L. Reintroduction of recently exterminated species of fauna at Mesa Verde. Colorado Conservation Comments, Denver, vol. 8, no. 1, p. 1. March 15, 1945. (Mountain sheep, wild turkey.)

O'BRIEN, E. Where man-eating tigers occur. Jour. Bombay Nat. Hist. Soc., vol. 45, no. 2, pp. 231–232. April, 1945.

O'Connor, Jack. The desert bighorn problem. Arizona Wildlife & Sportsman, Tucson, vol. 6, no. 5, pp. 8–9, illus. March, 1945.

Olson, Everett C. Origin of mammals based upon cranial morphology of the therapsid suborders. Geol. Soc. America, Baltimore, Special papers no. 55, pp. xi + 136, figs. 27. June, 1944.

Osgood, Wilfred H. A new rodent from Dutch New Guinea. Fieldiana, Zool., Chicago Nat. Hist. Mus., vol. 31, no. 1, pp. 2. September 19, 1945. (New: *Paraleptomys rufilatus*.)

Perkins, Jack E. Biology at Little America III, the west base of the United States Antarctic Service expedition 1939–1941. Proc. Amer. Philos. Soc., Philadelphia, vol. 89, no. 1, pp. 270–284, figs. 23. April 30, 1945. (Seals, pp. 277–281.)

Pitt, Frances. Breeding of the harvest mouse in captivity. Nature, London, vol. 155, no. 3945, p. 700. June 9, 1945.

Preble, Edward A. The American cougar. Nature Mag., Washington, vol. 38, no. 3, p. 137, illus. March, 1945.

Prentice, Arthur C. Let's get back to breeding quality foxes. Nat. Fur Breeder, Denver, vol. 17, no. 3, p. 4. April, 1945.

Pulling, Albert Van S. Non-breeding in bighorn sheep. Jour. Wildlife Management, Menasha, vol. 9, no. 2, pp. 155, 156. April, 1945.

Reid, "Chub". Boating for beaver. Fur-Fish-Game, Harding's Mag., Columbus, vol. 79, no. 4, pp. 34–36, illus. April, 1945.

Riggs, E. S. A rare cameloid from the late Pleistocene sands of southwestern Kansas. Trans. Kansas Acad. Sci., Lawrence, vol. 48, no. 1, pp. 101–104, figs. 2. June, 1945. (*Eschatius conidens* Cope.)

——— Some early Miocene carnivores. Field Mus. Nat. Hist., Geol. Ser., Chicago, vol. 9, no. 3, publ. 573, pp. 69–114, figs. 23–45. October 4, 1945.

Roller, Jane W. Gifts of the Americas. The guinea pig. Agriculture in the Americas, U. S. Dept. Agric., Office of Foreign Agric. Relations, Washington, vol. 5, no. 6, p. 119. June, 1945.

Rollings, Clair T. Habits, foods and parasites of the bobcat in Minnesota. Jour. Wildlife Management, Menasha, vol. 9, no. 2, pp. 131–145, pls. 4–5. April, 1945.

Ross, Keneth I. Wildlife of Mesa Verde National Park. Colorado Conservation Comments, Denver, vol. 8, no. 1, p. 3. March 15, 1945.

Rush, William M. American sable. Fauna, Philadelphia, vol. 7, no. 2, pp. 57–58. June, 1945.

Ruud, Johan T. Further studies on the structure of the baleen plates and their application to age determination. Hvalrådets Skrifter, no. 29, Norske Vidensk.-Akad., Oslo, pp. 69, figs. 28. August 13, 1945.

Scheffer, Theo. H. Burrow associations of small mammals. Murrelet, Seattle, vol. 26, no. 2, pp. 24–26. May–August (August 10), 1945.

Scheffer, Victor B. An 1884 list of the birds and mammals of Washington. Murrelet, Seattle, vol. 26, no. 2, pp. 29–30. May–August (August 10), 1945.

Schermerhorn, Jacqueline. Bouncing pocketbooks. San Diego Zoonooz, vol. 18, no. 3, pp. 4–5, illus. March, 1945. (Wallaroo.)

——— Black-outs. San Diego Zoonooz, vol. 18, no. 6, pp. 6–7, illus. June, 1945. (Black leopard.)

Schmidt, Karl P. In inland Chicago—the whales of all the world's seas and oceans. Chicago Nat. Hist. Mus. Bull., vol. 16, nos. 7–8, pp. 1–3, figs. 4. July–August, 1945. (Questions and answers.)

Seagears, Clayton B. The fox in New York. Western New York Conservationist, Buffalo, vol. 5, no. 2, pp. 5–6, February 1945; no. 3, pp. 5–6, March 1945; no. 5, pp. 5, 7, 10, May 1945.

Sheehan, John F., and Joyce A. Bruner. The care, breeding habits, and vaginal smear cycle of the laboratory hamster (Cricetus auratus). Turtox News, Chicago, vol. 23, no. 4, pp. 65–68, illus. April, 1945.

SIMPSON, GEORGE GAYLORD. The principles of classification and a classification of mammals. Bull. Amer. Mus. Nat. Hist., New York, vol. 85, pp. xvi + 350. October 5, 1945.

SINGHER, H. O., and L. MARINELLI. Distribution of radioactive sulfur in the rat. Science, Lancaster, n. s., vol. 101, no. 2625, pp. 414–415. April 20, 1945.

SIVERTSEN, ERLING. On the biology of the harp seal, *Phoca groenlandica* Erxl. Investigations carried out in the White Sea, 1925–1937. Hvalrådets Skrifter, no. 26, Norske Vidensk.-Akad., Oslo, pp. ix + 166, figs. 41, pls. 11. 1941.

SKERRETT, R. G. A modern Noah's ark. Compressed Air, New York, vol. 50, no. 7, pp. 185–187, illus. July, 1945. (Small scale models of mammals made by Louis Paul Jonas.)

SOLLARS, KATHRYN. The sea otter comes back. Fauna, Philadelphia, vol. 7, no. 1, pp. 11–13, illus. March, 1945.

SPENCE, REGINALD. Experiences with buffalo in Burma and Rhodesia. Jour. Bombay Nat. Hist. Soc., vol. 45, no. 2, pp. 232–233. April, 1945.

STONEY, R. F. On the name of the Indian pangolin (*Manis crassicaudata* Geoffr). Jour. Bombay Nat. Hist. Soc., vol. 45, no. 2, p. 233. April, 1945.

STORER, TRACY I. Field rodent control by destruction of burrows. Jour. Wildlife Management, Menasha, vol. 9, no. 2, pp. 156–157. April, 1945.

STOTT, KEN, JR. Lo, the gentle lamb. San Diego Zoonooz, vol. 18, no. 3, pp. 3–4. March, 1945. (Bighorn.)

STRAUSS, FRITZ. Vergleichende Beurteilung der Placentation bei den Insektivoren. Revue Suisse Zool., Bern, vol. 49, no. 19, pp. 269–282, figs. 11. September, 1942.

———— Die Bedeutung des placentaren Blutbeutels in vergleichender Betrachtung. Revue Suisse Zool., Bern, vol. 51, no. 14, pp. 360–368. July, 1944.

———— Kritische Bemerkungen zur Dreikeimblättertheorie. Verhandl. Schweizer. Naturforsch. Gesell., Sils 1944, pp. 134–135.

———— Die Implantation des Keimes die Frühphase der Placentation und die Menstruation im Licht vergleichendembryologischer Erfahrungen. Anat. Inst. Univ. Bern, pp. 72, figs. 23. 1944.

———— Die Abhängigkeit der Implantation von der Anordnung und dem Funktionszustand der Uterusgefässe. Monatsschr. f. Geburtshilfe und Gynäkol., Basel, vol. 118, fasc. 5/6, pp. 249–273, figs. 11. November–December, 1944.

———— Gedanken zur Entwicklung des Amnions und des Dottersackes beim Menschen. Revue Suisse Zool., Bern, vol. 52, no. 5, pp. 213–229, figs. 24. 1945.

SWALLOW, W. A. Polecat or Jimmie Skunk. Our Dumb Animals, Norwood, vol. 78, no. 7, p. 125, illus. July, 1945.

SWANSON, GUSTAV. Minnesota's fossil mammals. Conservation Volunteer, St. Paul, vol. 8, no. 45, pp. 22–25, illus. March–April, 1945.

TORREY, THEODORE W. The development of the urinogenital system of the albino rat. II. The gonads. Amer. Jour. Anat., Philadelphia, vol. 76, no. 3, pp. 375–397, pls. 2. May, 1945.

TYRRELL, W. BRYANT. In re rabbits. Nature Mag., Washington, vol. 38, no. 3, pp. 138–139, illus. March, 1945.

ULMER, FREDERICK A., JR. A naturalist in uniform sees England. Fauna, Philadelphia, vol. 7, no. 2, pp. 50–53, illus. June, 1945.

VALLOIS, HENRI V. Nomenclature anthropologique. Rev. Sci. (Revue Rose Illus.), Paris, no. 3, pp. 181–183. March, 1941.

WATTS, R. L. Bushy tails like butternuts. Pennsylvania Game News, Harrisburg, vol. 15, no. 12, p. 15, illus. March, 1945. (Squirrels.)

WEBSTER, R. Ivory: Its varieties and imitations. Gemmologist, London, vol. 13, no. 154, pp. 45–47, May 1944; no. 155, pp. 51–54, June 1944; no. 156, pp. 57–59, July 1944; vol. 14, no. 157, pp. 4–5, August 1944; no. 158, pp. 9–11, September 1944; no. 159, pp. 16–17, October 1944; no. 160, pp. 19–21, November 1944; no. 161, pp. 28–29,

December 1944; no. 162, pp. 31–32, January 1945; no. 163, pp. 39–41, February 1945; no. 164, pp. 46–47, March 1945; no. 165, pp. 52–53, April 1945; no. 166, pp 56–59, May 1945; no. 167, pp. 64–65, June 1945; no. 168, pp. 67–69, July 1945; vol. 15, no. 169, pp. 2–3, August 1945.

WISSLER, CLARK. The domestication of animals. Nat. Hist., New York, vol. 54, no. 5, pp. 200–206, illus. May, 1945.

WOOD, HORACE ELMER, 2ND. Late Miocene beaver from southeastern Montana. Amer. Mus. Novitates, New York, no. 1299, pp. 6, fig. 1. October 17, 1945.

WOODWARD, ALVALYN E., and JOHN M. CONDRIN. Physiological studies on hibernation in the chipmunk. Physiological Zool., Chicago, vol. 18, no. 2, pp. 162–167. April, 1945.

WUESTENBERG, R. W. Intestinal diseases versus ranch technique. Amer. Fur Breeder, Duluth, vol. 18, no. 3, pp. 54, 56. September, 1945.

YOUNG, STANLEY P. Bullets beyond the breakers. Amer. Rifleman, Washington, vol. 93, no. 6, pp. 8–9, 27, illus. June, 1945. (Sea otter.)